# Supplement I

## Additional materials to

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## Morphometrical analysis of metacarpal and metatarsal bones of cave bears (Carnivorarsidae)

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# METACARPAL BONE I (MTC I)

## Males and females

Table S1. Sample numbers (N), means (M), and standard errors (m) of the variables of mtc I among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus* | 1 | 54.2 | | no data | | no data | 1 | 8.7 |
| *U. deningeri* | 48 | 62.8±0.71 | 48 | 24.2±0.30 | 48 | 21.5±0.30 | 48 | 12.2±0.18 |
| *U. k. praekudarensis* | 12 | 69.4±1.96 | 13 | 26.7±0.92 | 13 | 21.6±0.84 | 14 | 13.4±0.46 |
| *U. k. kudarensis* | 61 | 69.7±0.40 | 65 | 28.8±0.28 | 64 | 26.5±0.32 | 63 | 14.6±0.15 |
| *U. savini* | 1 | 53.9 | 1 | 22.00 | 1 | 16.8 | 1 | 11.5 |
| *U. rossicus* | 11 | 50.0±0.92 | 7 | 18.6±0.25 | 7 | 16.1±0.41 | 7 | 9.8±0.20 |
| *U. s. spelaeus* | 7 | 59.6±0.83 | 7 | 22.8±0.29 | 6 | 21.1±0.53 | 7 | 11.8±0.18 |
| *U. k. kanivetz* | 23 | 62.4±0.87 | 24 | 24.2±0.59 | 24 | 22.0±0.63 | 24 | 12.6±0.35 |
| *U. s. eremus* | 20 | 63.2±1.01 | 20 | 24.5±0.60 | 20 | 22.0±0.61 | 20 | 12.6±0.30 |
| *U. s. ladinicus* | 10 | 62.0±1.54 | 10 | 23.7±1.00 | 10 | 21.5±0.72 | 10 | 13.0±0.56 |
| *U. k. ingressus* | 54 | 66.0±0.54 | 21 | 25.1±0.57 | 21 | 21.6±0.71 | 54 | 13.0±0.16 |
| *U. arctos* | 25 | 73.0±1.96 | 26 | 22.4±0.79 | 21 | 21.4±0.79 | 26 | 10.7±0.36 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus* | 1 | 13.5 | 1 | 11.4 |
| *U. deningeri* | 47 | 18.4±0.24 | 44 | 16.6±0.18 |
| *U. k. praekudarensis* | 14 | 20.5±0.72 | 14 | 18.2±0.54 |
| *U. k. kudarensis* | 61 | 21.8±0.21 | 55 | 18.7±0.14 |
| *U. savini* | 1 | 17.2 | 1 | 15.1 |
| *U. rossicus* | 11 | 14.9±0.32 | 7 | 13.0±0.19 |
| *U. s. spelaeus* | 7 | 17.6±0.33 | 5 | 16.8±0.65 |
| *U. k. kanivetz* | 23 | 18.8±0.36 | 21 | 17.2±0.39 |
| *U. s. eremus* | 20 | 18.4±0.33 | 20 | 18.1±0.29 |
| *U. s. ladinicus* | 10 | 18.6±0.64 | 10 | 17.4±0.47 |
| *U. k. ingressus* | 51 | 19.2±0.23 | 39 | 18.5±0.25 |
| *U. arctos* | 25 | 17.7±0.58 | 20 | 15.6±0.55 |

## Sexual size dimorphism

Table S2. Sexual size dimorphism (SSD and ASSD) of mtc I in the different forms of cave bears and brown bear; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 67.9±0.83 | 26.5±0.34 | 23.0±0.47 | 13.3±0.22 | 20.3±0.22 | 17.8±0.21 | |
| Females | 60.2±0.57 | 23.1±0.24 | 20.8±0.31 | 11.6±0.18 | 17.5±0.17 | 15.9±0.13 | |
| *SSD* | 6.0±0.79 (<0.001) | 6.9±0.83 (<0.001) | 4.9±1.3 (<0.001) | 6.6±1.14 (<0.001) | 7.5±0.75 (<0.001) | 5.7±0.75 (<0.001) | 6.28 |
| *v, %* | 77.6 | 78.7 | 40.4 | 59.0 | 85.1 | 77.4 | |
| | | | | *U. rossicus* | | | |
| Males | 53.8±1.83 | | | | 15.0±0.58 | | |
| Females | 48.6±0.48 | 18.6±0.25 | 16.14±0.41 | 9.8±0.20 | 14.9±0.41 | 12.9±0.19 | |
| *SSD* | 5.1±1.85 (0.01) | no data | no data | no data | 0.5±2.37 n.s. | no data | - |

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| *v, %* | - | - | - | - | - | - | |
| | | | | *U. k. praekudarensis* | | | |
| Males | 72.6±0.92 | 28.5±0.44 | 23.4±0.58 | 14.3±0.31 | 22.0±0.38 | 19.3±0.24 | |
| Females | 60.6±1.14 | 22.6±0.58 | 18.7±0.84 | 11.6±0.48 | 17.0±0.63 | 15.6±0.56 | |
| *SSD* | 9.0±1.1 (0.009) | 11.6±1.4 (0.003) | 11.2±2.4 (0.003) | 10.6±2.2 (0.002) | 12.8±1.9 (0.002) | 10.5±1.8 (0.002) | 10.97 |
| *v, %* | 93.3 | 89.8 | 81.3 | 85.8 | 88.9 | 91.6 | |
| | | | | *U. k. kudarensis* | | | |
| Males | 70.5±0.40 | 29.7±0.22 | 27.2±0.32 | 14.9±0.15 | 22.2±0.18 | 18.9±0.11 | |
| Females | 66.6±0.50 | 26.0±0.54 | 24.3±0.57 | 13.4±0.22 | 19.9±0.43 | 17.8±0.35 | |
| *SSD* | 2.9±0.47 (<0.001) | 6.6±1.04 (<0.001) | 5.8±1.3 (<0.001) | 5.4±0.95 (<0.001) | 5.5±1.10 (<0.001) | 3.0±0.99 (0.005) | 4.86 |
| *v, %* | 53.5 | 71.3 | 45.7 | 50.1 | 55.0 | 37.2 | |
| | | | | *U. s. spelaeus* | | | |
| Males | 61.4±0.73 | 22.3±0.60 | 22.5±0.55 | 11.9±0.37 | 16.9±0.50 | 14.4 | |
| Females | 58.3±0.90 | 23.1±0.16 | 20.4±0.44 | 11.8±0.18 | 18.1±0.26 | 17.4±0.33 | |
| *SSD* | 2.5±0.97 (0.05) | | 5.1±1.32 n.s. | 0.9±1.75 n.s. | | | - |
| *v, %* | - | - | - | - | - | - | |
| | | | | *U. s. ladinicus* | | | |
| Males | 68.0±1.15 | 27.6±1.59 | 24.5±0.60 | 14.9±1.20 | 21.0±1.11 | 19.1±0.80 | |
| Females | 59.5±1.15 | 22.1±0.49 | 20.2±0.33 | 12.1±0.24 | 17.5±0.34 | 16.6±0.29 | |
| *SSD* | 6.6±1.3 (0.02) | 11.1±3.4 (0.02) | 9.7±1.5 (0.02) | 10.4±4.5 (0.04) | 8.9±3.0 (0.04) | 6.9±2.4 (0.04) | 8.96 |
| *v, %* | 81.0 | 82.3 | 91.5 | 72.5 | 78.1 | 75.6 | |
| | | | | *U. s. eremus* | | | |
| Males | 66.8±0.85 | 26.7±0.52 | 24.3±0.35 | 13.8±0.21 | 19.5±0.31 | 19.1±0.21 | |
| Females | 59.6±0.84 | 22.2±0.30 | 19.7±0.50 | 11.5±0.22 | 17.3±0.30 | 17.0±0.24 | |
| *SSD* | 5.7±0.94 (<0.001) | 9.3±1.2 (<0.001) | 10.5±1.4 (<0.001) | 9.0±1.2 (<0.001) | 5.9±1.2 (<0.001) | 6.0±0.90 (<0.001) | 7.74 |
| *v, %* | 78.1 | 85.3 | 85.1 | 84.8 | 70.5 | 81.3 | |
| | | | | *U. k. kanivetz* | | | |
| Males | 69.2±0.54 | 27.5±0.24 | 24.4±0.42 | 13.9±0.14 | 20.6±0.17 | 19.7±0.17 | |
| Females | 63.0±0.42 | 32.1±0.24 | 19.7±0.40 | 12.0±0.13 | 17.9±0.17 | 17.0±0.13 | |
| *SSD* | 4.7±0.52 (<0.001) | 8.6±0.67 (<0.001) | 10.7±1.34 (0.005) | 7.3±0.74 (<0.001) | 6.8±0.62 (<0.001) | 7.3±0.58 (<0.001) | 7.56 |
| *v, %* | 85.2 | 85.3 | 62.6 | 82.9 | 86.5 | 86.2 | |
| | | | | *U. k. kanivetz* | | | |
| Males | 66.4±1.21 | 27.1±0.67 | 25.0±0.71 | 14.1±0.49 | 20.4±0.37 | 18.4±0.32 | |
| Females | 60.0±0.49 | 22.2±0.23 | 19.8±0.32 | 11.5±0.18 | 17.6±0.23 | 16.3±0.27 | |
| *SSD* | 5.1±1.04 (<0.001) | 9.9±1.5 (<0.001) | 11.6±1.8 (<0.001) | 10.2±2.04 (<0.001) | 7.2±1.2 (<0.001) | 6.3±1.7 (0.002) | 8.38 |
| *v, %* | 66.5 | 84.1 | 84.3 | 74.4 | 78.8 | 59.3 | |
| | | | | *U. arctos* | | | |
| Males | 81.9±1.91 | 26.1±0.94 | 23.7±0.70 | 12.5±0.40 | 20.5±0.60 | 17.7±0.43 | |
| Females | 67.0±1.59 | 19.7±0.50 | 19.3±0.73 | 9.5±0.25 | 15.7±0.32 | 14.0±0.26 | |
| *SSD* | 10.1±1.7 (<0.001) | 14.0±2.4 (<0.001) | 10.2±2.4 (0.004) | 13.5±2.2 (<0.001) | 13.4±1.9 (<0.001) | 11.7±1.6 (<0.001) | 12.13 |

**Univariate analysis**

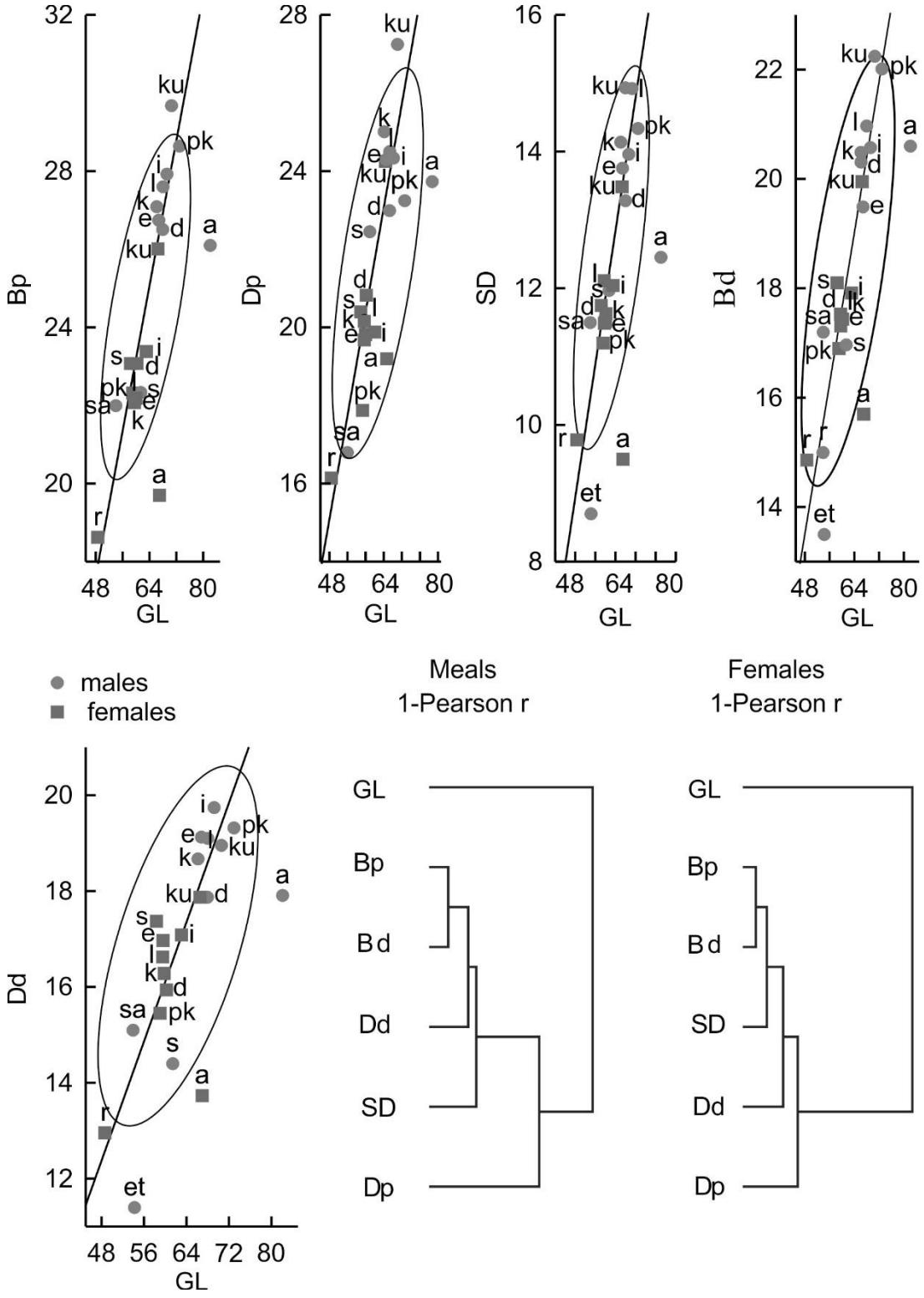


Fig. S1. The scatterplots of measures (GL – Dd) of mtc I and their UPMGA classification: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*.

Table S3. Statistical parameters of measures of mtc I among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | Std.Dev. | BP - N | BP | Std.Dev. | Dp- N | Dp | Std.Dev. | SD - N | SD | Std.Dev. | Bd - N | Bd | Std.Dev. | Dd- N | Dd | Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | m | 1 | 54.2 | | | | | | | | 1 | 8.7 | | 1 | 13.5 | | 1 | 11.4 | |
| *U. savini* | m | 1 | 53.9 | | 1 | 22.0 | 0.00 | 1 | 16.8 | 0.00 | 1 | 11.5 | | 1 | 17.2 | | 1 | 15.1 | |
| *U. rossicus* | f | 8 | 48.6 | 1.36 | 7 | 18.6 | 0.67 | 7 | 16.1 | 1.08 | 7 | 9.8 | 0.52 | 8 | 14.9 | 1.16 | 7 | 13.0 | 0.50 |
| | m | 3 | 53.8 | 3.18 | | | | | | | | | | 3 | 15.0 | 1.00 | | | |
| *U. deningeri* | f | 32 | 60.2 | 3.22 | 32 | 23.1 | 1.34 | 32 | 20.8 | 1.75 | 32 | 11.6 | 1.00 | 31 | 17.4 | 0.95 | 29 | 15.9 | 0.76 |
| | m | 16 | 67.9 | 3.33 | 16 | 26.5 | 1.35 | 16 | 23.0 | 1.88 | 16 | 13.3 | 0.88 | 16 | 20.3 | 0.90 | 15 | 17.9 | 0.87 |
| *U. k. praekudar.* | f | 3 | 59.0 | 1.17 | 4 | 22.3 | 1.37 | 4 | 17.9 | 0.78 | 4 | 11.2 | 0.71 | 4 | 16.9 | 1.61 | 4 | 15.5 | 1.35 |
| | m | 9 | 72.9 | 2.86 | 9 | 28.6 | 1.40 | 9 | 23.2 | 1.88 | 10 | 14.3 | 0.99 | 10 | 22.0 | 1.20 | 10 | 19.3 | 0.77 |
| *U. k. kudarensis* | f | 13 | 66.5 | 2.05 | 15 | 26.0 | 2.08 | 15 | 24.3 | 2.21 | 14 | 13.5 | 0.82 | 13 | 20.0 | 1.68 | 12 | 17.9 | 1.42 |
| | m | 48 | 70.6 | 2.85 | 50 | 29.7 | 1.52 | 49 | 27.2 | 2.30 | 49 | 14.9 | 1.07 | 48 | 22.2 | 1.26 | 43 | 19.0 | 0.79 |
| *U. s. spelaeus* | f | 4 | 58.3 | 1.80 | 4 | 23.1 | 0.32 | 4 | 20.4 | 0.88 | 4 | 11.8 | 0.37 | 4 | 18.1 | 0.54 | 4 | 17.4 | 0.67 |
| | m | 3 | 61.4 | 1.27 | 3 | 22.3 | 1.04 | 2 | 22.5 | 0.78 | 3 | 12.0 | 0.64 | 3 | 17.0 | 0.87 | 1 | 14.4 | 0.00 |
| *U. k. kanivetz* | f | 14 | 60.0 | 1.84 | 14 | 22.2 | 0.85 | 14 | 19.8 | 1.20 | 14 | 11.5 | 0.66 | 14 | 17.6 | 0.87 | 13 | 16.3 | 1.06 |
| | m | 9 | 66.1 | 3.99 | 10 | 27.1 | 2.13 | 10 | 25.0 | 2.25 | 10 | 14.1 | 1.55 | 9 | 20.5 | 1.18 | 8 | 18.7 | 1.76 |
| *U. s. eremus* | f | 10 | 59.6 | 2.64 | 10 | 22.2 | 0.93 | 10 | 19.7 | 1.57 | 10 | 11.5 | 0.70 | 10 | 17.3 | 0.96 | 10 | 17.0 | 0.77 |
| | m | 10 | 66.8 | 2.67 | 10 | 26.7 | 1.63 | 10 | 24.3 | 1.10 | 10 | 13.8 | 0.65 | 10 | 19.5 | 1.00 | 10 | 19.1 | 0.67 |
| *U. s. ladinicus* | f | 7 | 59.5 | 3.05 | 7 | 22.1 | 1.29 | 7 | 20.2 | 0.88 | 7 | 12.1 | 0.64 | 7 | 17.5 | 0.91 | 7 | 16.6 | 0.76 |
| | m | 3 | 68.0 | 1.99 | 3 | 27.6 | 2.75 | 3 | 24.5 | 1.04 | 3 | 14.9 | 2.07 | 3 | 21.0 | 1.93 | 3 | 19.1 | 1.39 |
| *U. k. ingressus* | f | 28 | 63.0 | 2.22 | 13 | 23.4 | 1.48 | 13 | 19.9 | 2.47 | 28 | 12.0 | 0.67 | 27 | 17.9 | 0.91 | 18 | 17.1 | 0.73 |
| | m | 26 | 69.2 | 2.85 | 8 | 27.9 | 1.00 | 8 | 24.3 | 2.38 | 26 | 14.0 | 0.74 | 24 | 20.6 | 0.93 | 21 | 19.7 | 0.90 |
| *U. k. kanivetz* | f | 14 | 60.0 | 1.84 | 14 | 22.2 | 0.85 | 14 | 19.8 | 1.20 | 14 | 11.5 | 0.66 | 14 | 17.6 | 0.87 | 13 | 16.3 | 1.06 |
| | m | 9 | 66.1 | 3.99 | 10 | 27.1 | 2.13 | 10 | 25.0 | 2.25 | 10 | 14.1 | 1.55 | 9 | 20.5 | 1.18 | 8 | 18.7 | 1.76 |
| *U. arctos* | f | 15 | 67.0 | 6.15 | 15 | 19.7 | 1.93 | 11 | 19.2 | 3.20 | 15 | 9.5 | 0.96 | 15 | 15.7 | 1.26 | 11 | 13.7 | 0.94 |
| | m | 10 | 82.1 | 6.66 | 11 | 26.1 | 3.12 | 10 | 23.7 | 2.43 | 11 | 12.5 | 1.31 | 10 | 20.6 | 2.07 | 9 | 17.9 | 1.55 |

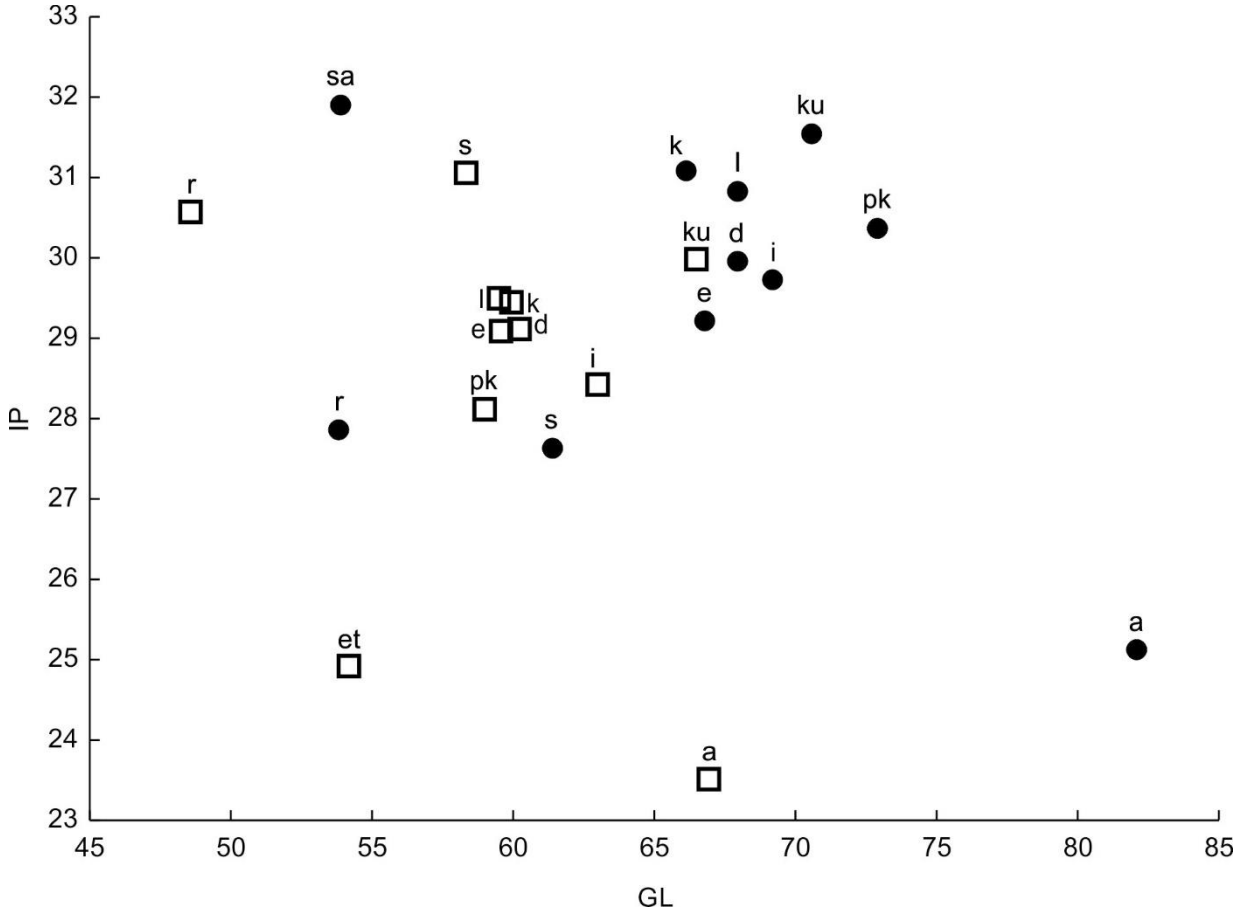


Fig. S2. The scatterplot of Index plumpness (ip) and GL of mtc I: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, sa – *U. savini*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females

Table S4. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtc I. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 1.75 | 1.90 | 4.65 | 3.01 | 4.79 | 1.44 | 0.73 | 0.74 | 2.93 |
| *U. rossicus* | 2 | 2.35 | | 2.84 | 5.23 | 3.97 | 5.36 | 2.69 | 1.94 | 0.41 | 4.00 |
| *U. k. praekudarensis* | 3 | 0.05 | 1.01 | | 0.12 | 0.32 | 0.30 | 0.85 | 1.12 | 2.01 | 0.30 |
| *U. k. kudarensis* | 4 | 3.32 | 4.69 | 1.05 | | 0.35 | 0.49 | 1.70 | 1.89 | 2.89 | 0.91 |
| *U. s. spelaeus* | 5 | 2.20 | 3.62 | 0.95 | 0.10 | | 0.10 | 1.48 | 1.72 | 2.64 | 0.86 |
| *U. k. ingressus* | 6 | 5.00 | 5.90 | 1.47 | 1.20 | 0.94 | | 1.94 | 2.09 | 3.03 | 1.23 |
| *U. k. kanivetz* | 7 | 2.26 | 3.90 | 0.70 | 0.97 | 0.61 | 2.25 | | 0.42 | 1.58 | 0.90 |
| *U. s. eremus* | 8 | 1.78 | 3.56 | 0.53 | 1.46 | 0.95 | 2.82 | 0.48 | | 1.13 | 1.22 |
| *U. s. ladinicus* | 9 | 0.41 | 1.12 | 0.26 | 2.19 | 1.84 | 2.93 | 1.62 | 1.35 | | 2.31 |
| *U. arctos* | 10 | 0.68 | 2.74 | 0.17 | 2.47 | 1.68 | 3.91 | 1.48 | 1.02 | 0.76 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 1.93 | 2.13 | 4.69 | 1.67 | 4.67 | 2.92 | 1.20 | 0.59 | 1.30 |
| *U. rossicus* | 2 | 1.99 | | 3.26 | 5.53 | 2.92 | 5.60 | 4.12 | 2.50 | 0.67 | 0.80 |
| *U. k. praekudarensis* | 3 | 0.05 | 0.95 | | 0.18 | 0.49 | 0.77 | 0.10 | 0.85 | 2.02 | 2.89 |
| *U. k. kudarensis* | 4 | 3.81 | 5.08 | 1.78 | | 0.92 | 1.18 | 0.09 | 1.43 | 2.76 | 5.81 |
| *U. s. spelaeus* | 5 | 2.19 | 3.33 | 1.43 | 0.18 | | 1.49 | 0.69 | 0.38 | 1.66 | 2.51 |
| *U. k. ingressus* | 6 | 3.50 | 4.77 | 1.76 | 0.03 | 0.19 | | 0.85 | 1.95 | 3.13 | 5.65 |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. k. kanivetz* | 7 | 2.98 | 4.36 | 1.45 | 0.63 | 0.24 | 0.61 | | 1.11 | 2.37 | 3.84 |
| *U. s. eremus* | 8 | 2.81 | 4.24 | 1.33 | 0.93 | 0.42 | 0.89 | 0.27 | | 1.33 | 2.05 |
| *U. s. ladinicus* | 9 | 1.05 | 2.16 | 0.75 | 1.03 | 0.72 | 1.02 | 0.64 | 0.49 | | 0.15 |
| *U. arctos* | 10 | 2.62 | 0.30 | 1.14 | 6.01 | 3.72 | 5.56 | 5.16 | 5.08 | 2.44 | |
| | | | | Dp | | | | | | | |
| *U. deningeri* | 1 | | 1.61 | 2.87 | 4.29 | 2.01 | 4.74 | 3.58 | 1.81 | 0.03 | 1.24 |
| *U. rossicus* | 2 | 2.22 | | 3.69 | 4.61 | 2.97 | 5.12 | 4.29 | 2.76 | 1.00 | 0.59 |
| *U. k. praekudarensis* | 3 | 0.00 | 1.10 | | 0.48 | 0.70 | 0.56 | 0.31 | 0.72 | 1.92 | 3.65 |
| *U. k. kudarensis* | 4 | 2.87 | 4.53 | 1.27 | | 0.46 | 1.67 | 0.99 | 0.49 | 1.95 | 5.28 |
| *U. s. spelaeus* | 5 | 1.39 | 2.84 | 0.83 | 0.49 | | 1.40 | 1.05 | 0.06 | 1.36 | 2.83 |
| *U. k. ingressus* | 6 | 3.41 | 4.89 | 1.67 | 0.86 | 1.08 | | 0.23 | 1.37 | 2.59 | 5.60 |
| *U. k. kanivetz* | 7 | 2.23 | 3.95 | 1.03 | 0.47 | 0.16 | 1.25 | | 1.06 | 2.26 | 4.39 |
| *U. s. eremus* | 8 | 2.60 | 4.27 | 1.18 | 0.17 | 0.37 | 0.99 | 0.30 | | 1.27 | 2.58 |
| *U. s. ladinicus* | 9 | 0.52 | 1.79 | 0.35 | 1.00 | 0.51 | 1.47 | 0.72 | 0.90 | | 0.66 |
| *U. arctos* | 10 | 2.75 | 0.54 | 1.41 | 4.97 | 3.23 | 5.30 | 4.40 | 4.72 | 2.14 | |
| | | | | SD | | | | | | | |
| *U. deningeri* | 1 | | 1.94 | 0.77 | 3.58 | 3.40 | 5.43 | 2.67 | 0.37 | 0.79 | 1.78 |
| *U. rossicus* | 2 | 2.05 | | 2.24 | 4.69 | 4.43 | 6.04 | 3.89 | 1.76 | 0.48 | 0.50 |
| *U. k. praekudarensis* | 3 | 1.14 | 0.04 | | 1.52 | 2.34 | 2.91 | 1.52 | 0.26 | 1.21 | 2.08 |
| *U. k. kudarensis* | 4 | 2.40 | 3.88 | 2.18 | | 1.63 | 2.78 | 0.46 | 1.64 | 2.43 | 5.49 |
| *U. s. spelaeus* | 5 | 2.13 | 3.36 | 2.28 | 0.54 | | 0.35 | 1.03 | 2.41 | 3.01 | 4.51 |
| *U. k. ingressus* | 6 | 3.38 | 4.66 | 2.55 | 0.79 | 0.04 | | 1.06 | 2.84 | 3.38 | 7.13 |
| *U. k. kanivetz* | 7 | 2.79 | 4.16 | 2.39 | 0.50 | 0.18 | 0.23 | | 1.65 | 2.39 | 3.99 |
| *U. s. eremus* | 8 | 0.80 | 2.57 | 1.48 | 1.45 | 1.53 | 2.28 | 1.87 | | 0.93 | 1.54 |
| *U. s. ladinicus* | 9 | 0.50 | 1.68 | 1.26 | 0.76 | 1.03 | 1.19 | 1.03 | 0.06 | | 0.18 |
| *U. arctos* | 10 | 3.67 | 1.01 | 0.52 | 5.71 | 4.46 | 6.75 | 5.93 | 4.14 | 2.45 | |
| | | | | Bd | | | | | | | |
| *U. deningeri* | 1 | | 1.71 | 1.18 | 4.36 | 1.90 | 4.92 | 3.27 | 0.20 | 0.39 | 1.74 |
| *U. rossicus* | 2 | 2.63 | | 2.24 | 4.97 | 2.98 | 5.42 | 4.20 | 1.44 | 0.70 | 0.30 |
| *U. k. praekudarensis* | 3 | 0.30 | 0.78 | | 1.01 | 0.37 | 1.43 | 1.19 | 0.82 | 1.17 | 2.22 |
| *U. k. kudarensis* | 4 | 1.35 | 3.46 | 0.76 | | 0.65 | 1.04 | 0.53 | 2.29 | 2.39 | 6.14 |
| *U. s. spelaeus* | 5 | 0.89 | 2.61 | 0.71 | 0.02 | | 1.16 | 0.90 | 1.31 | 1.61 | 3.09 |
| *U. k. ingressus* | 6 | 2.78 | 4.59 | 1.16 | 1.12 | 0.72 | | 0.07 | 2.73 | 2.74 | 6.61 |
| *U. k. kanivetz* | 7 | 1.86 | 3.86 | 0.92 | 0.43 | 0.27 | 0.68 | | 2.24 | 2.40 | 4.54 |
| *U. s. eremus* | 8 | 0.62 | 2.96 | 0.50 | 0.71 | 0.49 | 1.95 | 1.16 | | 0.47 | 1.35 |
| *U. s. ladinicus* | 9 | 0.07 | 1.73 | 0.31 | 0.67 | 0.58 | 1.35 | 0.94 | 0.26 | | 0.55 |
| *U. arctos* | 10 | 4.02 | 0.46 | 1.01 | 4.84 | 3.28 | 6.48 | 5.38 | 4.29 | 2.22 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 1.67 | 1.20 | 4.84 | 1.91 | 5.18 | 2.05 | 0.47 | 0.58 | 0.73 |
| *U. rossicus* | 2 | 2.18 | | 2.24 | 4.58 | 2.70 | 4.89 | 2.98 | 1.64 | 0.65 | 1.12 |
| *U. k. praekudarensis* | 3 | 0.12 | 1.01 | | 1.26 | 0.88 | 1.63 | 0.39 | 0.57 | 1.34 | 1.62 |
| *U. k. kudarensis* | 4 | 3.86 | 4.93 | 1.22 | | 0.15 | 0.91 | 1.01 | 2.03 | 2.82 | 5.16 |
| *U. s. spelaeus* | 5 | 2.39 | 3.60 | 1.05 | 0.16 | | 0.15 | 0.64 | 1.34 | 1.95 | 2.22 |
| *U. k. ingressus* | 6 | 3.21 | 4.42 | 1.09 | 0.27 | 0.04 | | 1.48 | 2.38 | 3.12 | 5.49 |
| *U. k. kanivetz* | 7 | 2.23 | 3.71 | 0.64 | 1.52 | 0.90 | 1.13 | | 1.03 | 1.84 | 2.51 |
| *U. s. eremus* | 8 | 2.82 | 4.16 | 0.80 | 1.14 | 0.62 | 0.77 | 0.44 | | 0.81 | 0.91 |
| *U. s. ladinicus* | 9 | 0.86 | 2.14 | 0.35 | 1.34 | 1.01 | 1.12 | 0.40 | 0.67 | | 0.17 |
| *U. arctos* | 10 | 1.42 | 0.77 | 0.65 | 4.45 | 3.11 | 3.91 | 3.12 | 3.60 | 1.64 | |

## Multivariate analyses

Table S5. Description of the modeled morphological spaces for cave bears and brown bear mtc I. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E3, K1–K3); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | | "Shape" morphospace | | | $r^2$ | "Size" morpho-space | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | E3 | K1 | K2 | K3 | | E1 | K1 | K2 | |
| GL | 0.73 | 0.62 | 0.26 | -0.18 | 0.20 | -0.38 | 0.95 | 0.89 | 0.06 | 0.38 | 0.86 |
| Bp | 0.97 | -0.02 | 0.01 | 0.09 | -0.42 | -0.58 | 0.98 | 0.97 | -0.07 | 0.27 | 0.95 |
| Dp | 0.88 | 0.13 | -0.40 | -0.30 | -0.50 | -0.35 | 0.99 | 0.88 | -0.44 | 0.24 | 0.92 |
| SD | 0.94 | -0.24 | 0.03 | 0.24 | -0.51 | -0.29 | 0.96 | 0.94 | -0.04 | -0.02 | 0.94 |
| Bd | 0.96 | 0.04 | 0.13 | 0.16 | -0.29 | -0.49 | 0.95 | 0.96 | 0.04 | 0.15 | 0.93 |
| Dd | 0.92 | -0.10 | 0.25 | 0.18 | -0.27 | -0.35 | 0.92 | 0.90 | 0.02 | 0.13 | 0.83 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 50.4 | 62.5 | 24.8 | 28.5 | 50.5 | 15.8 | | 56.1 | 4.5 | 14.2 | |

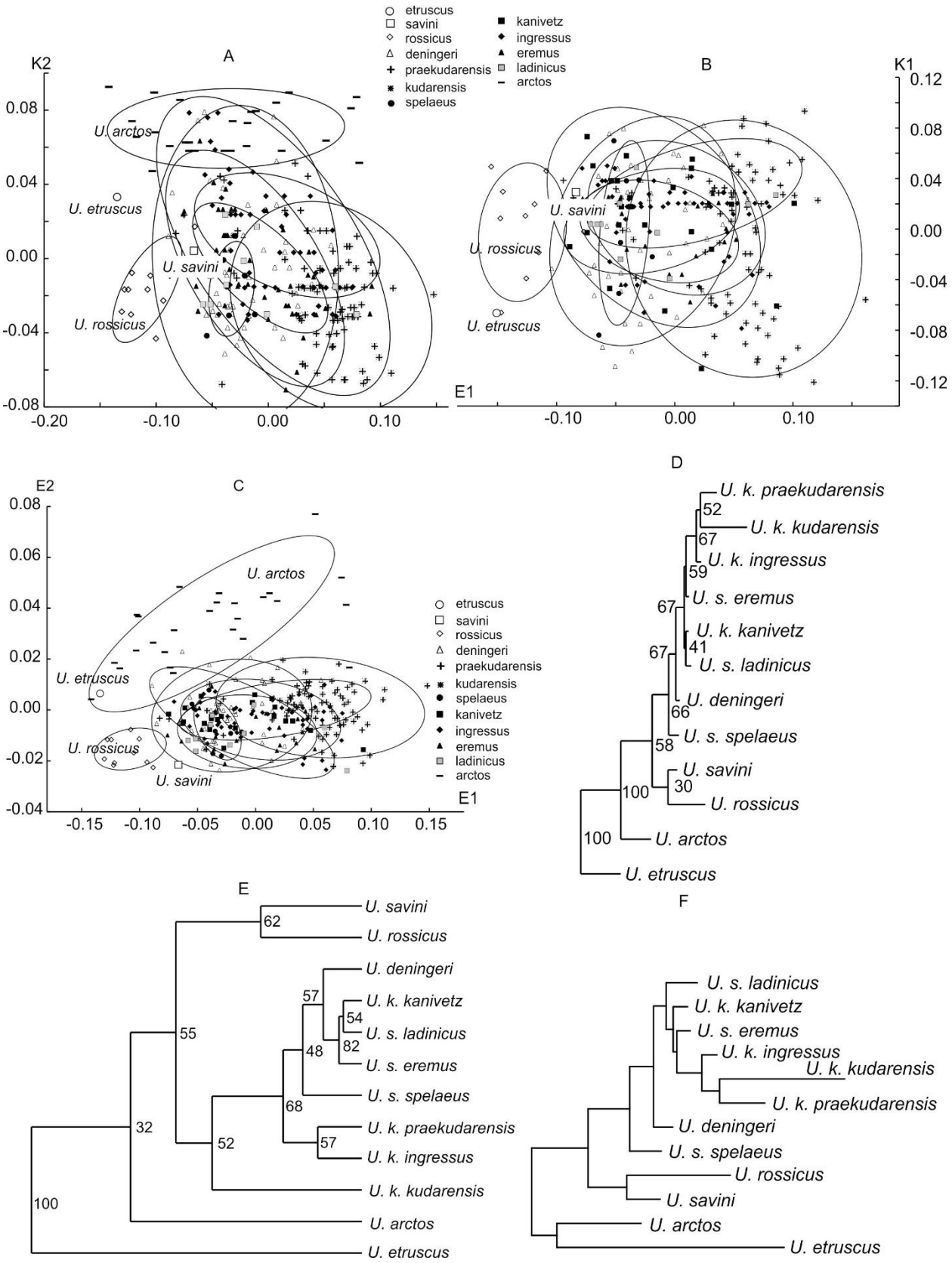


Fig. S3. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc I in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses'

horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S6. Description of the modeled morphological spaces of mtc I for males of cave bears and brown bear. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.61 | 0.41 | 0.22 | 0.05 | 0.80 | 0.67 | -0.47 | 0.45 | 0.14 | 0.92 |
| Bp | 0.92 | -0.07 | 0.03 | -0.26 | 0.86 | 0.91 | 0.09 | -0.20 | -0.00 | 0.85 |
| Dp | 0.76 | -0.70 | -0.28 | -0.70 | 0.88 | 0.74 | 0.68 | -0.48 | 0.46 | 0.95 |
| SD | 0.89 | -0.09 | -0.32 | -0.03 | 0.89 | 0.88 | 0.12 | -0.30 | -0.27 | 0.91 |
| Bd | 0.88 | 0.10 | 0.22 | -0.06 | 0.90 | 0.88 | -0.04 | -0.05 | -0.06 | 0.86 |
| Dd | 0.74 | 0.15 | -0.02 | 0.06 | 0.67 | 0.74 | -0.13 | 0.06 | -0.02 | 0.62 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 70.2 | 56.3 | 63.6 | 19.3 | | 76.9 | 26.6 | 18.4 | 7.5 | |

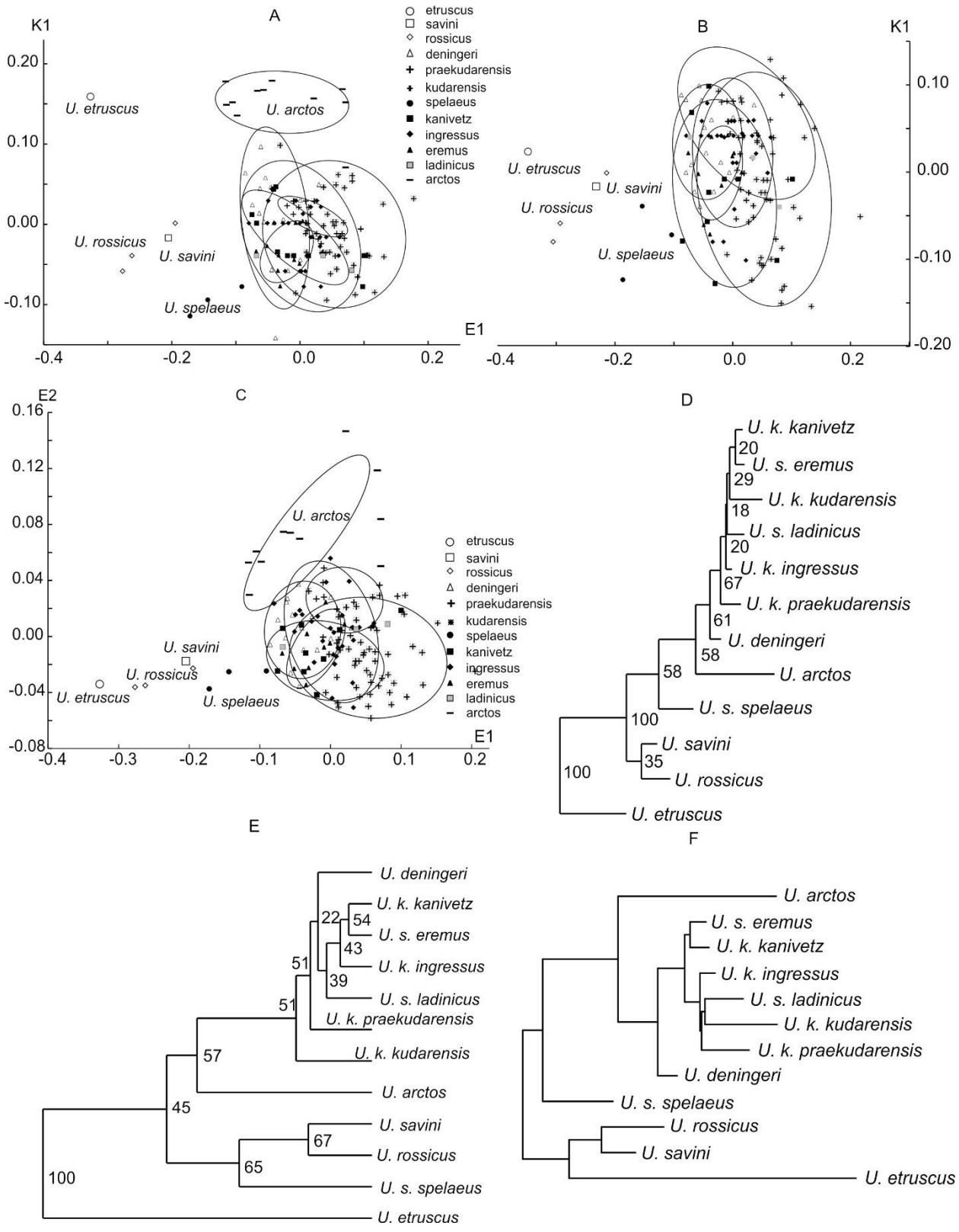


Fig. S4. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc I in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S7. Description of the modeled morphological spaces of mtc I for females of cave bears and brown bear. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E | K1 | K2 | |
| GL | 0.57 | 0.56 | 0.33 | -0.29 | 0.84 | 0.85 | -0.13 | -0.25 | 0.76 |
| Bp | 0.95 | -0.01 | -0.47 | 0.03 | 0.90 | 0.93 | -0.28 | -0.13 | 0.85 |
| Dp | 0.84 | 0.46 | -0.41 | -0.43 | 0.95 | 0.84 | -0.55 | -0.17 | 0.85 |
| SD | 0.90 | -0.27 | -0.53 | 0.18 | 0.91 | 0.89 | -0.19 | 0.27 | 0.91 |
| Bd | 0.93 | -0.10 | -0.35 | 0.20 | 0.89 | 0.92 | -0.06 | 0.00 | 0.84 |
| Dd | 0.89 | -0.21 | -0.22 | 0.31 | 0.90 | 0.86 | 0.17 | -0.19 | 0.88 |
| ip | 0.23 | -0.15 | -0.66 | 0.32 | 0.79 | 0.17 | 0.12 | 0.32 | 0.43 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | |
| | 68.8 | 59.9 | 39.5 | 31.6 | | 73.6 | 32.4 | 6.7 | |

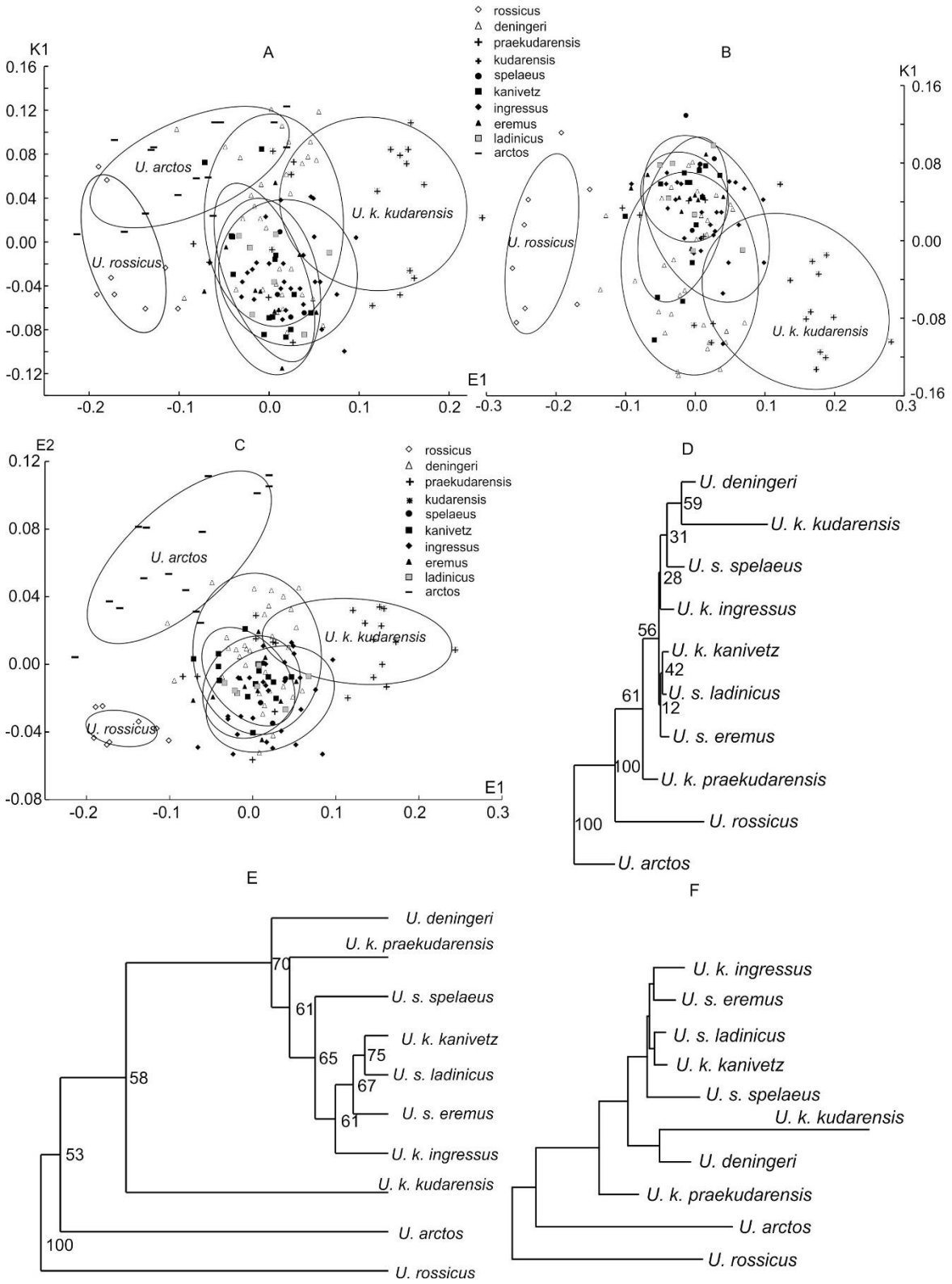


Fig. S5. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc I in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.95); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METACARPAL BONE II (MTC II)

## Males and females

Table S8. Sample numbers (N), means (M), and standard errors (m) of the variables of mtc II among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. deningeri* | 41 | 72.8±0.80 | 42 | 18.9±0.29 | 40 | 26.9±0.40 | 42 | 15.4±0.24 |
| *U. k. praekudarensis* | 10 | 83.4±1.85 | 14 | 22.2±0.66 | 12 | 32.7±1.06 | 14 | 17.5±0.57 |
| *U. k. kudarensis* | 72 | 83.7±0.51 | 74 | 22.2±0.20 | 74 | 31.7±0.28 | 75 | 17.3±0.18 |
| *U. savini* * | 1 | 56.8 | | no data | | no data | 1 | 9.9 |
| *U. rossicus* | 21 | 58.6±0.65 | 16 | 14.0±0.21 | 15 | 22.2±0.28 | 17 | 12.5±0.16 |
| *U. s. spelaeus* | 16 | 78.5±1.71 | 16 | 20.4±0.60 | 12 | 28.4±0.89 | 16 | 17.6±0.37 |
| *U. k. kanivetz* | 21 | 73.5±0.92 | 22 | 18.9±0.37 | 19 | 26.8±0.47 | 22 | 17.0±0.27 |
| *U. s. eremus* | 20 | 74.7±0.78 | 20 | 19.1±0.48 | 20 | 26.3±0.38 | 20 | 16.1±0.34 |
| *U. s. ladinicus* | 14 | 71.3±0.63 | 10 | 18.0±0.30 | 14 | 25.2±0.38 | 13 | 15.4±0.24 |
| *U. k. ingressus* | 53 | 78.4±0.78 | 20 | 21.6±0.44 | 19 | 28.9±0.56 | 52 | 17.8±0.27 |
| *U. arctos* | 26 | 80.8±2.29 | 25 | 16.0±0.59 | 22 | 24.9±1.08 | 26 | 12.3±0.49 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. deningeri* | 41 | 23.0±0.33 | 40 | 19.2±0.22 |
| *U. k. praekudarensis* | 13 | 26.2±0.75 | 9 | 22.7±0.78 |
| *U. k. kudarensis* | 68 | 26.9±0.23 | 65 | 22.0±0.13 |
| *U. savini* * | 1 | 16.9 | 1 | 14.3 |
| *U. rossicus* | 19 | 18.5±0.25 | 15 | 14.8±0.19 |
| *U. s. spelaeus* | 16 | 25.0±0.51 | 10 | 19.5±0.36 |
| *U. k. kanivetz* | 21 | 24.4±0.41 | 17 | 19.1±0.41 |
| *U. s. eremus* | 20 | 24.0±0.39 | 20 | 19.6±0.27 |
| *U. s. ladinicus* | 14 | 22.4±0.26 | 14 | 18.2±0.14 |
| *U. k. ingressus* | 50 | 24.8±0.21 | 36 | 20.2±0.25 |
| *U. arctos* | 26 | 20.2±0.66 | 23 | 17.7±0.56 |

* - female proposed

## Sexual dimorphism

Table S9. Sexual size dimorphism (SSD and ASSD) of mtc II in the different forms of cave bears and brown bear ; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 77.6±0.87 | 20.5±0.33 | 29.0±0.58 | 16.5±0.34 | 24.7±0.51 | 20.32±0.23 | |
| Females | 69.4±0.56 | 17.6±0.24 | 25.40±0.26 | 14.5±0.18 | 21.8±0.18 | 18.3±0.22 | |
| *SSD* | 5.6±0.70 (<0.001) | 7.6±1.07 (<0.001) | 6.6±1.17 (<0.001) | 6.5±1.24 (<0.001) | 6.2±1.17 (<0.001) | 5.2±0.83 (<0.001) | 6.28 |
| *v, %* | 76.6 | 69.9 | 64.5 | 56.8 | 63.7 | 65.3 | |
| | | | | *U. rossicus* | | | |
| Males | 61.1±1.14 | 14.9±0.33 | 22.9±0.34 | 13.0±0.15 | 19.5±0.23 | 15.3±0.30 | |
| Females | 57.2±0.43 | 13.6±0.17 | 22.0±0.34 | 12.3±0.18 | 17.8±0.18 | 14.6±0.23 | |

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| *SSD* | 3.3±1.03 (0.002) | 4.6±1.3 (0.01) | 2.0±1.07 n.s. | 2.8±1.93 (0.04) | 4.6±0.78 (<0.001) | 2.3±1.26 n.s. | 3.25 |
| *v, %* | 64.7 | 61.2 | - | 17.9 | 79.9 | - | |
| | | | | *U. k. praekudarensis* | | | |
| Males | 86.6±1.13 | 23.8±0.56 | 34.5±0.81 | 18.7±0.47 | 28.0±0.49 | 23.8±0.43 | |
| Females | 76.0±1.78 | 20.1±0.72 | 29.3±1.78 | 15.8±0.76 | 24.0±0.89 | 20.4±1.63 | |
| *SSD* | 6.5±1.3 (0.02) | 8.4±2.09 (0.01) | 8.2±3.08 (0.03) | 8.4±2.60 (0.02) | 7.7±1.96 (0.004) | 7.7±3.83 n.s. | 7.81 |
| *v, %* | 83.7 | 59.7 | 65.0 | 18.9 | 58.5 | - | |
| | | | | *U. k. kudarensis* | | | |
| Males | 86.5±0.43 | 23.1±0.23 | 32.5±0.34 | 18.2±0.17 | 27.8±0.27 | 22.4±0.15 | |
| Females | 79.9±0.53 | 21.0±0.24 | 30.6±0.39 | 16.2±0.25 | 25.5±0.24 | 21.4±0.14 | |
| *SSD* | 4.0±0.41 (<0.001) | 4.8±0.72 (<0.001) | 3.0±0.82 (0.002) | 5.8±0.88 (<0.001) | 4.3±0.68 (<0.001) | 2.3±0.47 (<0.001) | 4.03 |
| *v, %* | 70.6 | 55.3 | 18.4 | 47.8 | 51.4 | 36.8 | |
| | | | | *U. s. spelaeus* | | | |
| Males | 86.2±0.90 | 22.8±0.81 | 31.2±1.19 | 19.2±0.32 | 27.0±0.69 | 20.4±1.07 | |
| Females | 73.9±1.11 | 19.0±0.35 | 26.4±0.46 | 16.7±0.23 | 23.8±0.30 | 19.1±0.16 | |
| *SSD* | 7.7±0.9 (0.001) | 9.1±2.12 (0.001) | 8.3±2.22 (0.02) | 7.0±1.1 (0.001) | 6.3±1.48 (0.003) | 3.3±2.74 n.s. | 6.94 |
| *v, %* | 84.1 | 75.5 | 64.0 | 72.7 | 51.9 | - | |
| | | | | *U. s. ladinicus* | | | |
| Males | 73.4±0.87 | 19.0±0.41 | 26.1±0.43 | 16.2±0.39 | 23.1±0.24 | 18.3±0.35 | |
| Females | 70.2±0.58 | 17.4±0.23 | 24.7±0.48 | 15.0±0.20 | 22.1±0.32 | 18.1±0.10 | |
| *SSD* | 2.2±1.7 (0.01) | 4.5±1.29 (0.007) | 2.8±1.27 n.s. | 3.8±1.39 (0.03) | 2.3±0.89 n.s. | 0.5±1.0 n.s. | 2.71 |
| *v, %* | 52.5 | 62.4 | - | 51.3 | - | - | |
| | | | | *U. s. eremus* | | | |
| Males | 79.9±1.29 | 22.6±0.76 | 29.1±0.58 | 18.6±0.74 | 27.1±0.44 | 21.4±0.43 | |
| Females | 75.5±0.57 | 18.3±0.30 | 25.6±0.24 | 15.5±0.18 | 23.3±0.20 | 19.1±0.20 | |
| *SSD* | 4.2±0.92 (0.004) | 10.6±2.0 (0.003) | 6.3±1.16 (0.003) | 8.9±2.25 (0.003) | 7.6±0.97 (0.003) | 5.7±1.16 (0.004) | 7.22 |
| *v, %* | 78.5 | 85.6 | 85.5 | 84.6 | 91.4 | 80.1 | |
| | | | | *U. k. ingressus* | | | |
| Males | 83.6±0.81 | 23.0±0.38 | 30.6±0.45 | 19.7±0.22 | 27.1±0.27 | 21.4±0.25 | |
| Females | 74.5±0.59 | 19.9±0.40 | 26.6±0.40 | 16.4±0.20 | 23.2±0.17 | 18.9±0.14 | |
| *SSD* | 5.7±0.59 (<0.001) | 7.2±1.29 (<0.001) | 7.0±1.06 (0.005) | 9.1±0.83 (<0.001) | 7.8±0.64 (<0.001) | 6.2±0.71 (<0.001) | 7.17 |
| *v, %* | 80.5 | 80.3 | 81.7 | 87.5 | 90.8 | 73.1 | |
| | | | | *U. kanivetz* | | | |
| Males | 79.4±1.20 | 21.1±0.51 | 29.6±1.07 | 18.4±0.31 | 27.0±0.69 | 21.8±0.32 | |
| Females | 71.6±0.61 | 18.1±0.27 | 26.0±0.30 | 16.4±0.23 | 23.6±0.29 | 18.5±0.30 | |
| *SSD* | 5.2±0.89 (0.001) | 7.7±1.8 (0.001) | 6.5±2.0 (0.003) | 5.7±1.1 (<0.001) | 6.7±1.48 (0.002) | 8.2±1.1 (0.009) | 6.66 |
| *v, %* | 87.6 | 85.4 | 87.0 | 75.6 | 79.7 | 80.0 | |
| | | | | *U. arctos* | | | |
| Males | 92.6±2.40 | 19.1±0.36 | 29.5±0.88 | 15.0±0.52 | 23.7±0.64 | 20.2±0.48 | |
| Females | 75.5±1.62 | 13.9±0.40 | 21.1±0.78 | 10.7±0.28 | 18.0±0.42 | 15.8±0.45 | |
| *SSD* | 11.5±1.8 (<0.001) | 15.8±1.7 (<0.001) | 16.6±2.4 (0.004) | 16.8±2.4 (<0.001) | 13.8±1.9 (<0.001) | 12.2±1.8 (<0.001) | 14.46 |

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| *v, %* | 75.6 | 88.1 | 82.3 | 84.8 | 85.6 | 80.4 | |

## Univariate statistic

Table S10. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtc II. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 1.50 | 3.54 | 5.46 | 3.25 | 0.38 | 0.46 | 0.81 | 3.07 | 5.02 |
| *U. rossicus* | 2 | 2.31 | | 4.31 | 5.74 | 4.05 | 1.47 | 1.46 | 0.40 | 3.95 | 5.57 |
| *U. k. praekudarensis* | 3 | 2.31 | 3.45 | | 0.03 | 0.08 | 2.38 | 2.13 | 3.42 | 1.38 | 0.84 |
| *U. k. kudarensis* | 4 | 7.41 | 8.51 | 0.99 | | 0.07 | 2.92 | 2.52 | 4.20 | 2.22 | 1.21 |
| *U. s. spelaeus* | 5 | 2.44 | 4.08 | 0.75 | 3.01 | | 2.23 | 2.00 | 3.23 | 1.20 | 0.89 |
| *U. k. kanivetz* | 6 | 1.42 | 3.36 | 1.52 | 5.05 | 1.14 | | 0.09 | 0.96 | 1.61 | 3.30 |
| *U. s. eremus* | 7 | 2.78 | 4.54 | 0.82 | 3.63 | 0.05 | 1.24 | | 1.00 | 1.35 | 2.95 |
| *U. s. ladinicus* | 8 | 0.15 | 1.97 | 2.03 | 5.16 | 1.87 | 0.96 | 2.01 | | 2.83 | 4.41 |
| *U. k. ingressus* | 9 | 4.04 | 5.74 | 0.52 | 3.60 | 0.50 | 2.08 | 0.65 | 2.74 | | 2.65 |
| *U. arctos* | 10 | 2.51 | 4.31 | 0.96 | 3.91 | 0.27 | 1.00 | 0.25 | 1.80 | 0.94 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 1.87 | 3.75 | 4.66 | 2.09 | 0.45 | 1.94 | 1.05 | 3.27 | 1.27 |
| *U. rossicus* | 2 | 3.10 | | 4.45 | 4.77 | 3.18 | 1.91 | 3.00 | 0.66 | 4.07 | 0.81 |
| *U. k. praekudarensis* | 3 | 2.46 | 4.44 | | 0.74 | 1.13 | 2.56 | 0.86 | 3.72 | 0.74 | 4.42 |
| *U. k. kudarensis* | 4 | 5.50 | 7.47 | 0.83 | | 0.75 | 2.52 | 0.46 | 3.89 | 0.17 | 5.16 |
| *U. s. spelaeus* | 5 | 1.82 | 4.15 | 0.85 | 2.23 | | 1.34 | 0.13 | 2.50 | 0.53 | 2.88 |
| *U. k. kanivetz* | 6 | 0.71 | 3.46 | 1.87 | 4.12 | 1.13 | | 1.33 | 1.22 | 2.05 | 1.38 |
| *U. s. eremus* | 7 | 1.01 | 3.71 | 1.67 | 3.79 | 0.89 | 0.28 | | 2.38 | 0.31 | 2.66 |
| *U. s. ladinicus* | 8 | 0.43 | 2.13 | 2.46 | 4.40 | 1.86 | 0.95 | 1.19 | | 3.30 | 0.05 |
| *U. k. ingressus* | 9 | 2.83 | 4.97 | 0.03 | 1.02 | 0.92 | 2.11 | 1.87 | 2.71 | | 4.01 |
| *U. arctos* | 10 | 3.19 | 0.19 | 4.50 | 8.09 | 4.25 | 3.56 | 3.83 | 2.09 | 5.12 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 1.88 | 4.11 | 4.10 | 1.68 | 0.33 | 0.19 | 1.56 | 1.22 | 0.53 |
| *U. rossicus* | 2 | 2.91 | | 4.59 | 4.25 | 2.83 | 1.74 | 1.33 | 0.38 | 2.60 | 2.12 |
| *U. k. praekudarensis* | 3 | 1.89 | 3.58 | | 1.52 | 1.59 | 2.58 | 3.05 | 4.48 | 2.77 | 3.27 |
| *U. k. kudarensis* | 4 | 5.33 | 7.22 | 0.83 | | 0.68 | 1.90 | 2.45 | 4.16 | 2.08 | 2.75 |
| *U. s. spelaeus* | 5 | 1.09 | 3.17 | 0.89 | 2.39 | | 1.01 | 1.43 | 2.60 | 0.71 | 1.18 |
| *U. k. kanivetz* | 6 | 0.97 | 3.50 | 1.25 | 3.64 | 0.32 | | 0.41 | 1.45 | 0.50 | 0.05 |
| *U. s. eremus* | 7 | 0.31 | 2.98 | 1.66 | 4.44 | 0.81 | 0.62 | | 1.02 | 0.99 | 0.54 |
| *U. s. ladinicus* | 8 | 0.80 | 1.59 | 2.21 | 4.53 | 1.54 | 1.49 | 0.99 | | 2.34 | 1.83 |
| *U. k. ingressus* | 9 | 1.39 | 3.53 | 0.74 | 2.26 | 0.20 | 0.57 | 1.09 | 1.80 | | 0.60 |
| *U. arctos* | 10 | 2.90 | 0.08 | 3.57 | 7.35 | 3.16 | 3.50 | 2.97 | 1.54 | 3.52 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 1.74 | 2.95 | 2.98 | 3.36 | 2.12 | 1.92 | 0.47 | 5.73 | 1.26 |
| *U. rossicus* | 2 | 2.02 | | 3.74 | 3.63 | 4.07 | 3.10 | 2.89 | 1.01 | 5.45 | 0.69 |
| *U. k. praekudarensis* | 3 | 1.70 | 2.98 | | 1.09 | 0.62 | 0.47 | 0.31 | 2.62 | 1.38 | 3.69 |
| *U. k. kudarensis* | 4 | 3.97 | 5.27 | 0.68 | | 1.73 | 0.38 | 0.43 | 2.27 | 3.79 | 3.80 |
| *U. s. spelaeus* | 5 | 3.90 | 5.09 | 1.34 | 1.07 | | 1.02 | 0.81 | 3.01 | 0.51 | 4.04 |
| *U. k. kanivetz* | 6 | 4.00 | 5.26 | 1.08 | 0.70 | 0.43 | | 0.09 | 2.05 | 1.79 | 2.90 |
| *U. s. eremus* | 7 | 1.94 | 3.51 | 0.31 | 1.47 | 2.09 | 1.89 | | 1.94 | 1.40 | 2.63 |
| *U. s. ladinicus* | 8 | 0.64 | 2.18 | 1.00 | 2.19 | 2.65 | 2.51 | 0.90 | | 4.16 | 0.47 |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. k. ingressus* | 9 | 4.59 | 5.77 | 1.08 | 0.70 | 0.57 | 0.11 | 2.04 | 2.65 | | 6.09 |
| *U. arctos* | 10 | 2.95 | 0.62 | 3.61 | 6.59 | 6.00 | 6.35 | 4.46 | 2.88 | 7.13 | |
| | | | | | Bd | | | | | | |
| *U. deningeri* | 1 | | 2.21 | 3.26 | 4.35 | 2.12 | 1.79 | 1.72 | 1.08 | 2.92 | 0.69 |
| *U. rossicus* | 2 | 2.09 | | 4.66 | 5.70 | 3.61 | 3.26 | 3.10 | 0.69 | 4.57 | 1.42 |
| *U. k. praekudarensis* | 3 | 2.93 | 4.13 | | 0.50 | 0.82 | 0.95 | 0.81 | 3.44 | 1.17 | 3.52 |
| *U. k. kudarensis* | 4 | 6.95 | 7.57 | 1.33 | | 0.58 | 0.74 | 0.58 | 3.82 | 1.14 | 4.34 |
| *U. s. spelaeus* | 5 | 3.08 | 4.40 | 0.34 | 2.10 | | 0.16 | 0.08 | 2.57 | 0.12 | 2.48 |
| *U. k. kanivetz* | 6 | 3.41 | 4.76 | 0.49 | 2.65 | 0.15 | | 0.06 | 2.31 | 0.08 | 2.16 |
| *U. s. eremus* | 7 | 2.73 | 4.19 | 0.95 | 3.36 | 0.69 | 0.62 | | 2.24 | 0.00 | 2.07 |
| *U. s. ladinicus* | 8 | 0.44 | 2.08 | 2.21 | 4.60 | 2.15 | 2.23 | 1.70 | | 3.02 | 0.51 |
| *U. k. ingressus* | 9 | 3.12 | 4.58 | 1.06 | 4.04 | 0.81 | 0.77 | 0.06 | 1.81 | | 3.19 |
| *U. arctos* | 10 | 2.36 | 0.00 | 4.38 | 8.60 | 4.77 | 5.27 | 4.65 | 2.24 | 5.21 | |
| | | | | | DD | | | | | | |
| *U. deningeri* | 1 | | 1.81 | 4.48 | 4.86 | 0.40 | 1.55 | 1.22 | 1.35 | 2.11 | 0.16 |
| *U. rossicus* | 2 | 3.08 | | 5.03 | 4.91 | 1.60 | 2.59 | 2.38 | 0.37 | 3.23 | 1.80 |
| *U. k. praekudarensis* | 3 | 1.65 | 3.31 | | 1.64 | 2.66 | 1.63 | 2.25 | 4.65 | 3.04 | 4.00 |
| *U. k. kudarensis* | 4 | 5.86 | 7.65 | 1.11 | | 1.93 | 0.73 | 1.39 | 4.42 | 2.53 | 3.80 |
| *U. s. spelaeus* | 5 | 1.53 | 3.71 | 0.51 | 2.42 | | 0.89 | 0.56 | 1.28 | 0.73 | 0.28 |
| *U. k. kanivetz* | 6 | 0.46 | 3.20 | 1.35 | 4.61 | 1.09 | | 0.39 | 2.27 | 0.44 | 1.38 |
| *U. s. eremus* | 7 | 1.99 | 4.50 | 0.58 | 3.27 | 0.03 | 1.34 | | 2.03 | 0.05 | 1.03 |
| *U. s. ladinicus* | 8 | 0.55 | 1.99 | 1.83 | 4.72 | 1.71 | 0.86 | 2.01 | | 2.76 | 1.37 |
| *U. k. ingressus* | 9 | 1.53 | 4.16 | 0.84 | 3.84 | 0.38 | 0.92 | 0.46 | 1.66 | | 1.63 |
| *U. arctos* | 10 | 2.69 | 0.56 | 3.04 | 7.68 | 3.40 | 2.83 | 4.23 | 1.58 | 3.86 | |

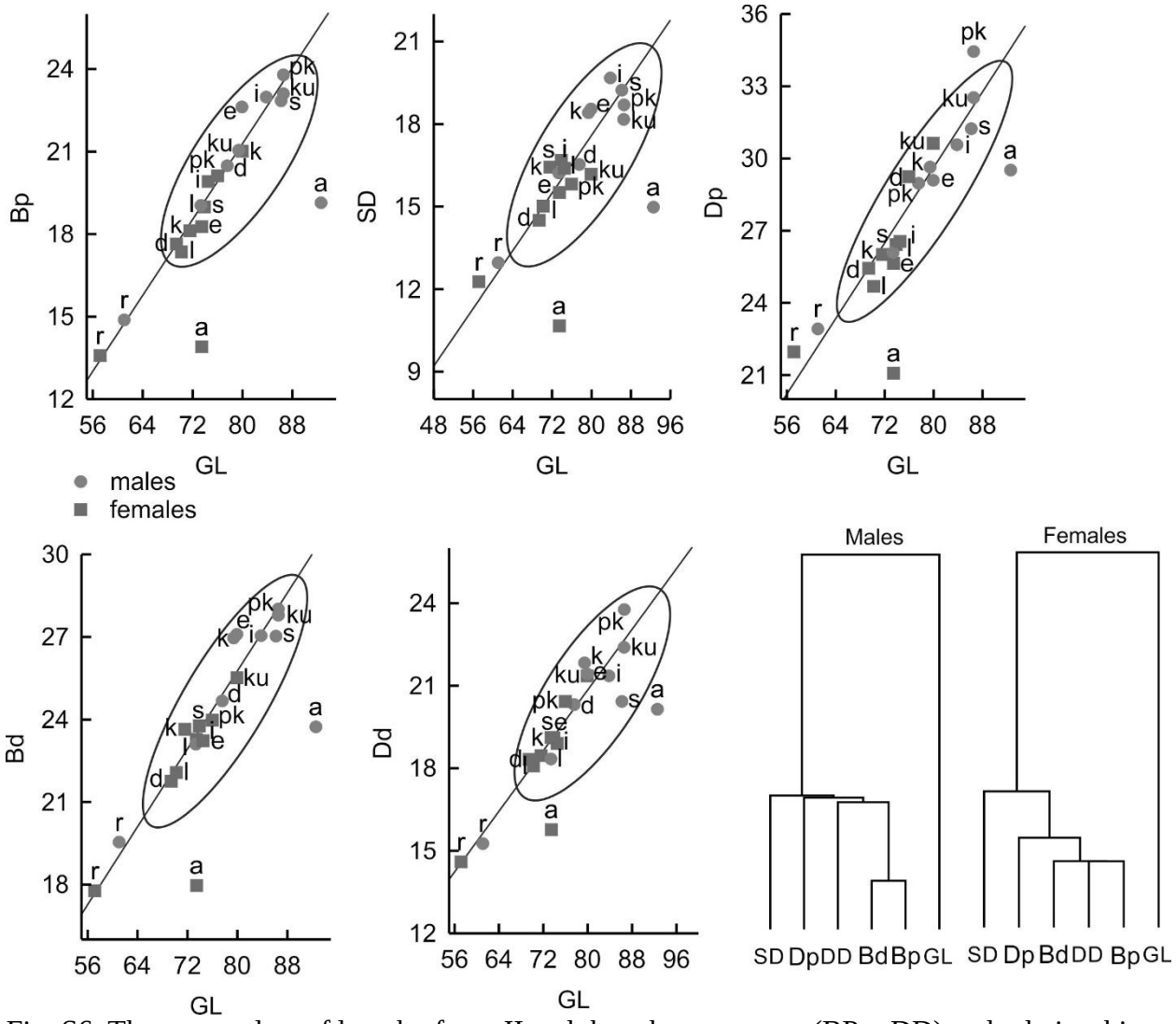


Fig. S6. The scatterplots of length of mtc II and the other measures (BP – DD) and relationships between measures of mtc II (single linkage, correlation distances used): et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. The dashed lines are lines of regressions and ellipses' horizontal and vertical projections onto the axes are equal to the "sample mean ± "sample range" x 0.95.

Table S11. Statistical parameters of measures of mtc II among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | Std.Dev. | BP - N | BP | Std.Dev. | Dp- N | Dp | Std.Dev. | SD - N | SD | Std.Dev. | Bd - N | Bd | Std.Dev. | Dd- N | Dd | Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. rossicus* | m | 8 | 61.1 | 3.24 | 5 | 14.9 | 0.73 | 4 | 22.9 | 0.68 | 5 | 13.0 | 0.33 | 8 | 19.5 | 0.65 | 5 | 15.3 | 0.67 |
| | f | 13 | 57.2 | 1.56 | 11 | 13.6 | 0.56 | 11 | 22.0 | 1.13 | 12 | 12.3 | 0.64 | 11 | 17.8 | 0.61 | 10 | 14.6 | 0.72 |
| *U. deningeri* | m | 17 | 77.6 | 3.60 | 18 | 20.5 | 1.41 | 17 | 29.0 | 2.39 | 18 | 16.5 | 1.45 | 17 | 24.7 | 2.09 | 17 | 20.3 | 0.97 |
| | f | 24 | 69.4 | 2.76 | 24 | 17.6 | 1.16 | 23 | 25.4 | 1.26 | 24 | 14.5 | 0.89 | 24 | 21.8 | 0.89 | 23 | 18.3 | 1.05 |
| *U. k. praekudar.* | m | 7 | 86.6 | 3.00 | 8 | 23.8 | 1.57 | 8 | 34.5 | 2.30 | 8 | 18.7 | 1.34 | 7 | 28.0 | 1.30 | 6 | 23.8 | 1.05 |
| | f | 3 | 76.0 | 3.09 | 6 | 20.1 | 1.76 | 4 | 29.3 | 3.56 | 6 | 15.8 | 1.87 | 6 | 24.0 | 2.19 | 3 | 20.4 | 2.82 |
| *U. k. kudarensis* | m | 41 | 86.6 | 2.73 | 43 | 23.1 | 1.36 | 43 | 32.5 | 2.25 | 44 | 18.2 | 1.15 | 40 | 27.8 | 1.69 | 40 | 22.4 | 0.98 |
| | f | 31 | 79.9 | 2.96 | 31 | 21.0 | 1.31 | 31 | 30.6 | 2.19 | 31 | 16.2 | 1.39 | 28 | 25.5 | 1.26 | 25 | 21.4 | 0.70 |
| *U. s. spelaeus* | m | 6 | 86.2 | 2.21 | 6 | 22.9 | 1.98 | 5 | 31.2 | 2.65 | 6 | 19.2 | 0.78 | 6 | 27.0 | 1.69 | 3 | 20.4 | 1.85 |
| | f | 10 | 73.9 | 3.52 | 10 | 19.0 | 1.11 | 7 | 26.4 | 1.21 | 10 | 16.7 | 0.74 | 10 | 23.8 | 0.95 | 7 | 19.1 | 0.44 |
| *U. k. kanivetz* | m | 5 | 79.4 | 2.68 | 6 | 21.1 | 1.24 | 4 | 29.7 | 2.14 | 6 | 18.4 | 0.75 | 5 | 27.0 | 1.54 | 3 | 21.8 | 0.55 |
| | f | 16 | 71.6 | 2.45 | 16 | 18.1 | 1.07 | 15 | 26.0 | 1.14 | 16 | 16.4 | 0.94 | 16 | 23.6 | 1.16 | 14 | 18.5 | 1.12 |
| *U. s. eremus* | m | 4 | 79.9 | 2.59 | 4 | 22.6 | 1.52 | 4 | 29.1 | 1.17 | 4 | 18.6 | 1.48 | 4 | 27.1 | 0.89 | 4 | 21.4 | 0.86 |
| | f | 16 | 73.5 | 2.29 | 16 | 18.3 | 1.19 | 16 | 25.6 | 0.95 | 16 | 15.5 | 0.73 | 16 | 23.3 | 0.81 | 16 | 19.1 | 0.78 |
| *U. s. ladinicus* | m | 5 | 73.4 | 1.94 | 5 | 19.0 | 0.91 | 5 | 26.1 | 0.97 | 5 | 16.2 | 0.87 | 5 | 23.1 | 0.54 | 5 | 18.3 | 0.78 |
| | f | 9 | 70.2 | 1.73 | 9 | 17.4 | 0.69 | 8 | 24.7 | 1.36 | 9 | 15.0 | 0.59 | 9 | 22.1 | 0.96 | 8 | 18.1 | 0.27 |
| *U. k. ingressus* | m | 22 | 83.8 | 3.26 | 11 | 23.0 | 1.26 | 11 | 30.6 | 1.51 | 22 | 19.7 | 1.03 | 21 | 27.1 | 1.22 | 19 | 21.4 | 1.09 |
| | f | 31 | 74.5 | 3.29 | 9 | 19.9 | 1.21 | 8 | 26.6 | 1.14 | 30 | 16.4 | 1.12 | 29 | 23.2 | 0.94 | 17 | 18.9 | 0.60 |
| *U. arctos* | m | 10 | 92.6 | 7.60 | 10 | 19.1 | 1.12 | 10 | 29.5 | 2.79 | 10 | 15.0 | 1.66 | 10 | 23.7 | 2.03 | 10 | 20.2 | 1.51 |
| | f | 16 | 73.5 | 6.48 | 15 | 13.9 | 1.53 | 12 | 21.1 | 2.70 | 16 | 10.7 | 1.12 | 16 | 18.0 | 1.66 | 13 | 15.8 | 1.62 |

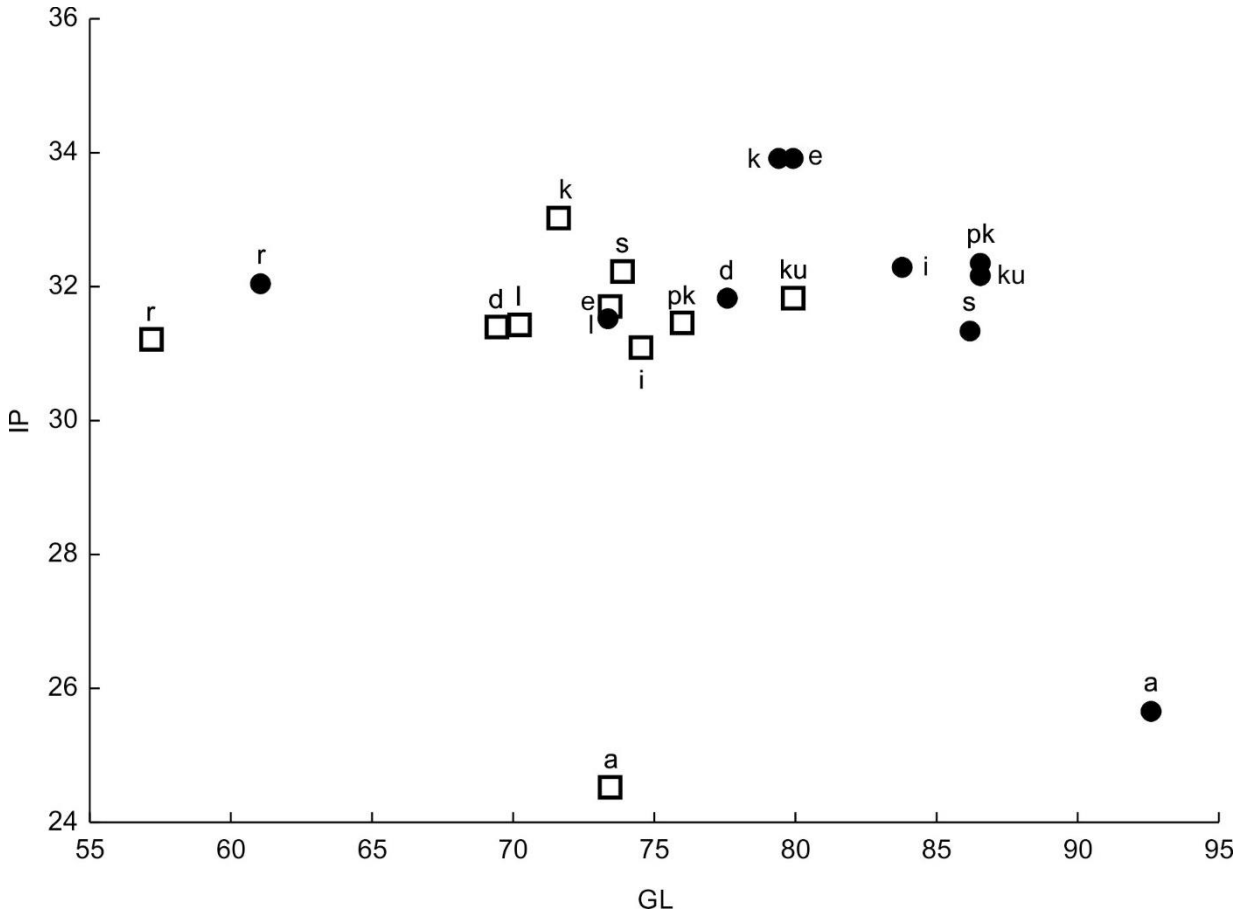


Fig. S7. The scatterplot of Index plumpness (ip) and GL of mtc II: a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. kanivetz*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females.

## Multivariate analysis

Table S12. Description of the modeled morphological spaces for cave bears and brown bear mtc II. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | | E1 | E2 | K1 | K2 | |
| GL | 0.83 | 0.49 | -0.41 | 0.89 | 0.96 | 0.09 | -0.51 | 0.17 | 0.93 |
| Bp | 0.96 | -0.07 | -0.04 | 0.93 | 0.95 | -0.10 | -0.32 | 0.41 | 0.97 |
| Dp | 0.95 | 0.18 | -0.24 | 0.96 | 0.94 | 0.22 | -0.52 | 0.23 | 0.94 |
| SD | 0.90 | -0.33 | 0.26 | 0.96 | 0.88 | -0.42 | -0.01 | 0.13 | 0.97 |
| Bd | 0.97 | -0.08 | -0.01 | 0.95 | 0.97 | -0.08 | -0.33 | 0.11 | 0.95 |
| Dd | 0.96 | 0.13 | -0.22 | 0.93 | 0.95 | 0.15 | -0.53 | 0.10 | 0.94 |
| ip | 0.31 | -0.33 | 0.20 | 0.65 | 0.28 | -0.34 | 0.27 | -0.09 | 0.28 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 62.9 | 70.5 | 64.8 | | 67.8 | 44.3 | 57.5 | 14.1 | |

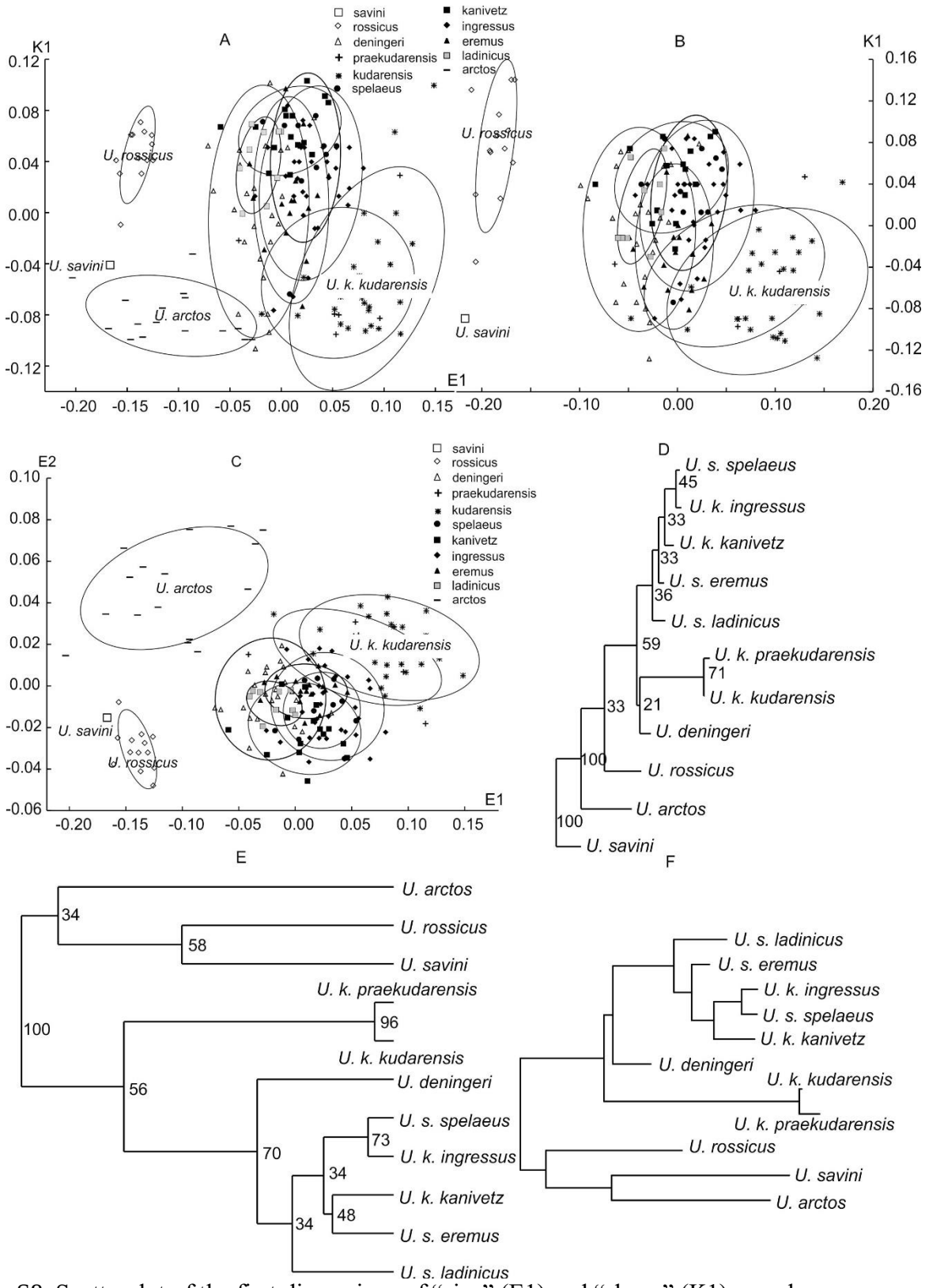


Fig. S8. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc II in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.89); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S13. Description of the modeled morphological spaces for males of cave bears and brown bear mtc II. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | | E1 | E2 | K1 | K2 | |
| GL | 0.72 | 0.56 | -0.30 | 0.78 | 0.93 | -0.14 | 0.18 | -0.00 | 0.89 |
| Bp | 0.92 | -0.14 | 0.16 | 0.88 | 0.93 | 0.04 | 0.00 | 0.10 | 0.89 |
| Dp | 0.91 | 0.30 | -0.25 | 0.90 | 0.91 | -0.36 | 0.39 | -0.06 | 0.91 |
| SD | 0.85 | -0.37 | 0.38 | 0.93 | 0.86 | 0.39 | -0.28 | 0.05 | 0.95 |
| Bd | 0.95 | -0.06 | 0.06 | 0.93 | 0.95 | -0.01 | 0.04 | -0.26 | 0.96 |
| Dd | 0.92 | 0.21 | -0.18 | 0.88 | 0.93 | -0.29 | 0.29 | -0.11 | 0.20 |
| ip | 0.27 | -0.27 | 0.31 | 0.52 | 0.24 | 0.27 | -0.30 | -0.53 | 0.46 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 79.9 | 74.0 | 50.9 | | 83.6 | 51.3 | 52.3 | 6.5 | |

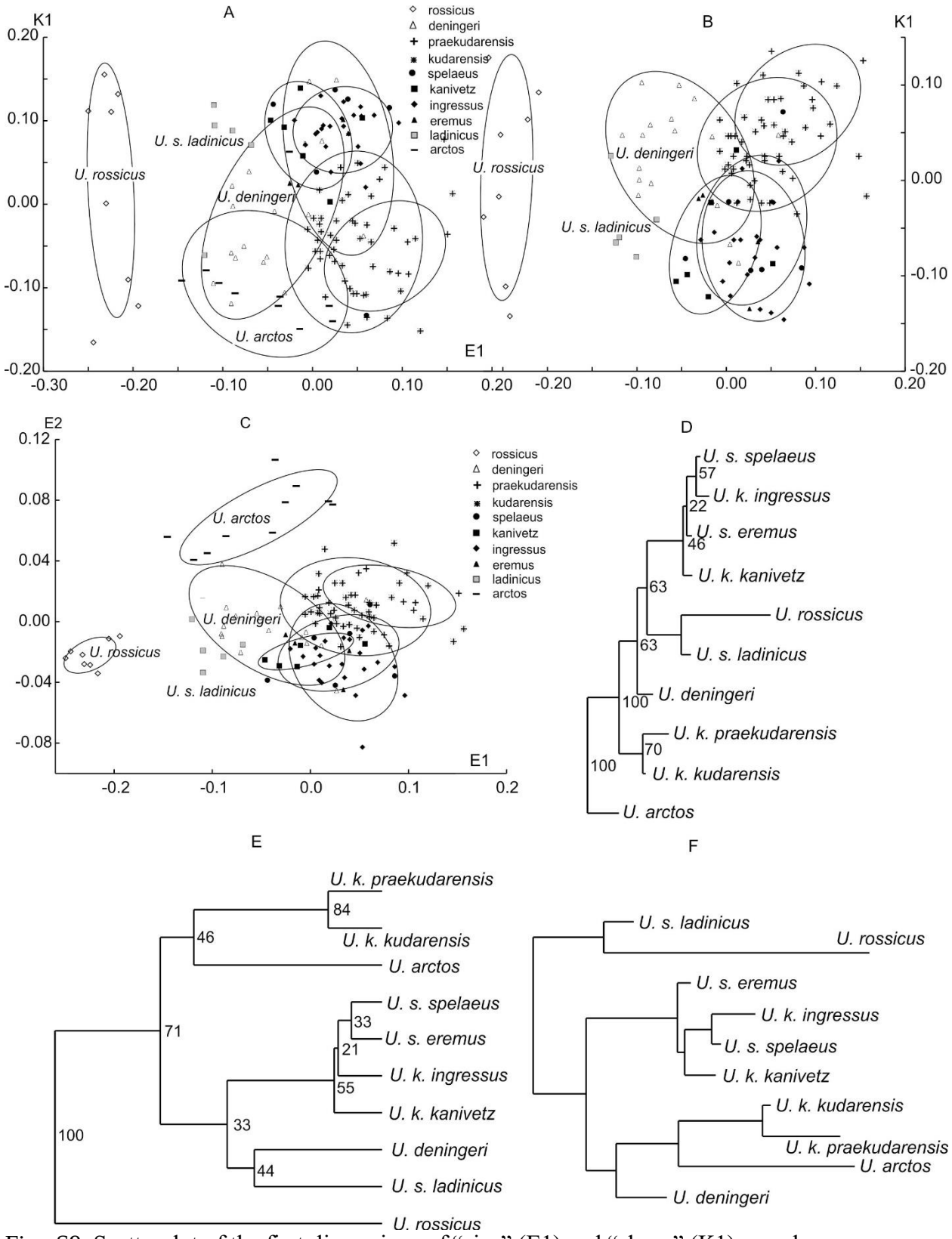


Fig. S9. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc II in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.88); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S14. Description of the modeled morphological spaces for females of cave bears and brown bear mtc II. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | K1 | K2 | |
| GL | 0.76 | 0.61 | -0.43 | -0.46 | 0.96 | 0.94 | -0.60 | 0.15 | 0.92 |
| Bp | 0.96 | -0.07 | 0.00 | -0.11 | 0.93 | 0.94 | -0.39 | 0.48 | 0.94 |
| Dp | 0.93 | 0.09 | -0.17 | -0.06 | 0.91 | 0.92 | -0.51 | 0.39 | 0.86 |
| SD | 0.88 | -0.40 | 0.40 | -0.18 | 0.96 | 0.82 | -0.01 | 0.05 | 0.90 |
| Bd | 0.97 | -0.13 | 0.11 | -0.23 | 0.95 | 0.96 | -0.37 | 0.17 | 0.92 |
| Dd | 0.96 | 0.09 | -0.13 | -0.17 | 0.92 | 0.94 | -0.56 | 0.18 | 0.91 |
| ip | 0.22 | -0.41 | 0.37 | 0.17 | 0.79 | 0.20 | 0.37 | 0.06 | 0.28 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 84.9 | 70.1 | 59.9 | 33.9 | | 85.7 | 50.1 | 21.6 | |

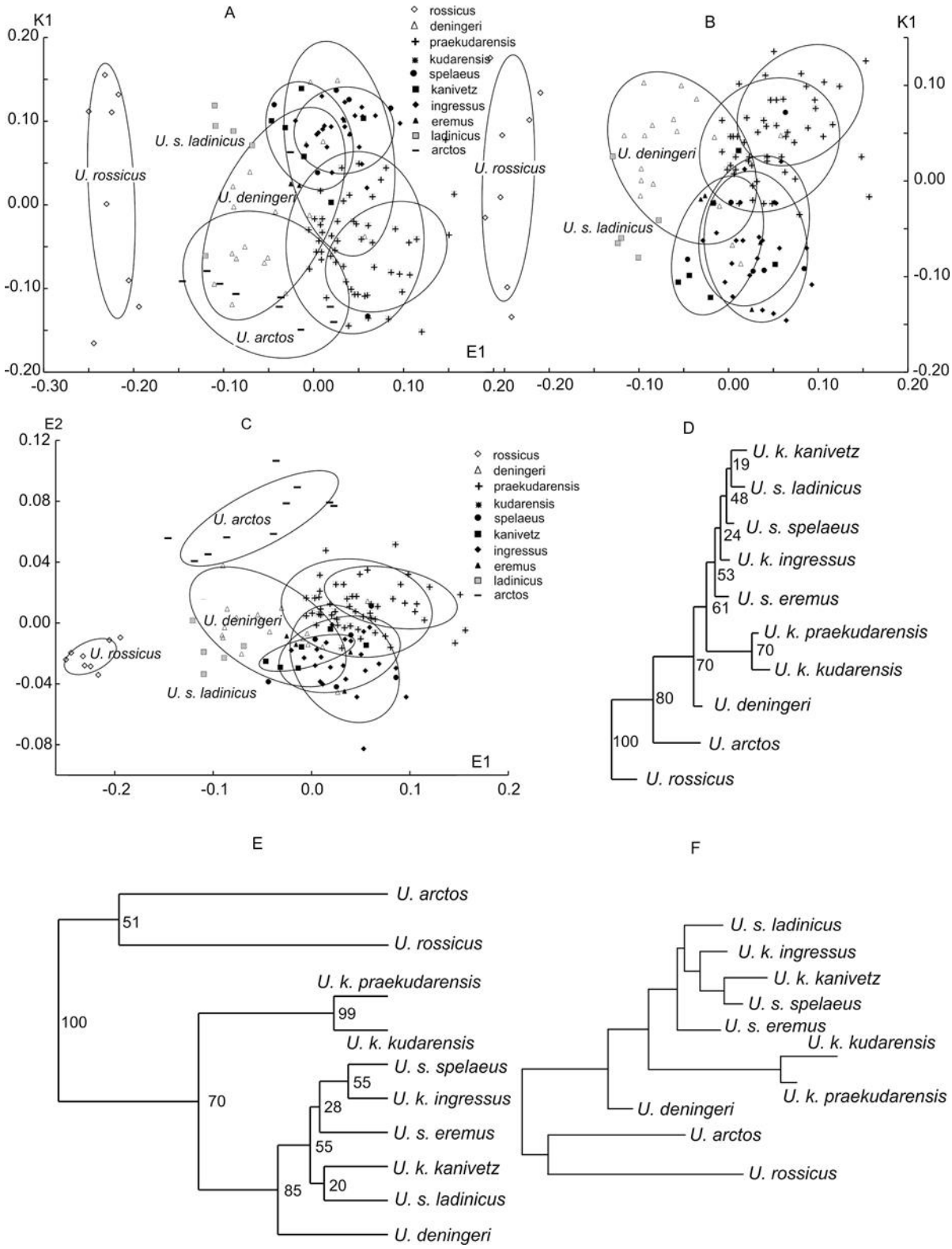


Fig. S10. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc II in females A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean"(centroid) ± "sample range" x 0.95.

# METACARPAL BONE III (MTC III)

## Males and females

Table S15. Sample numbers (N), means (M), and standard errors (m) of the variables of mtc III among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus* | 1 | 66.1 | | no data | | no data | 1 | 9.6 |
| *U. deningeri* | 34 | 76.1±0.80 | 34 | 19.1±0.30 | 31 | 27.4±0.49 | 36 | 14.7±0.20 |
| *U. k. praekudarensis* | 10 | 81.8±2.80 | 12 | 19.3±0.76 | 8 | 29.3±1.57 | 12 | 15.5±0.63 |
| *U. k. kudarensis* | 72 | 86.8±0.64 | 72 | 21.3±0.21 | 70 | 32.6±0.31 | 75 | 17.4±0.23 |
| *U. rossicus* | 19 | 62.3±0.87 | 15 | 16.3±0.40 | 15 | 22.1±0.35 | 15 | 13.3±0.25 |
| *U. s. spelaeus* | 14 | 82.3±1.68 | 14 | 20.5±0.64 | 7 | 29.7±1.16 | 14 | 16.8±0.43 |
| *U. k. kanivetz* | 17 | 77.4±1.15 | 17 | 19.1±0.30 | 17 | 27.4±0.53 | 17 | 15.6±0.39 |
| *U. s. eremus* | 20 | 81.0±1.25 | 20 | 20.7±0.46 | 20 | 30.7±0.59 | 20 | 16.5±0.39 |
| *U. s. ladinicus* | 13 | 75.1±1.28 | 13 | 18.3±0.44 | 13 | 28.2±0.69 | 13 | 14.4±0.27 |
| *U. k. ingressus* | 52 | 84.8±0.74 | 26 | 21.7±0.34 | 23 | 33.0±0.57 | 54 | 17.6±0.27 |
| *U. arctos* | 28 | 79.4±1.76 | 29 | 16.7±0.48 | 20 | 25.2±0.99 | 29 | 12.1±0.41 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus* | 1 | 15.9 | 1 | 12.9 |
| *U. deningeri* | 34 | 22.6±0.31 | 32 | 19.6±0.25 |
| *U. k. praekudarensis* | 11 | 24.3±0.97 | 10 | 21.3±0.79 |
| *U. k. kudarensis* | 69 | 26.5±0.27 | 71 | 22.5±0.19 |
| *U. rossicus* | 19 | 19.4±0.36 | 13 | 15.6±0.25 |
| *U. s. spelaeus* | 13 | 24.8±0.62 | 6 | 20.7±0.46 |
| *U. k. kanivetz* | 17 | 23.6±0.36 | 15 | 19.2±0.35 |
| *U. s. eremus* | 20 | 25.5±0.46 | 20 | 21.1±0.35 |
| *U. s. ladinicus* | 13 | 22.6±0.46 | 13 | 19.2±0.36 |
| *U. k. ingressus* | 50 | 25.4±0.34 | 38 | 20.9±0.29 |
| *U. arctos* | 28 | 19.1±0.52 | 19 | 17.3±0.54 |

### Sexual dimorphism

Table S16. Sexual size dimorphism (SSD and ASSD) of mtc III in the different forms of cave bears and brown bear ; p based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 89.4±2.11 | 21.5±0.31 | 33.9±0.52 | 17.3±0.48 | 26.8±0.46 | 23.2±0.71 | |
| Females | 73.9±0.70 | 18.2±0.30 | 26.1±0.41 | 14.1±0.22 | 21.7±0.24 | 19.0±0.24 | |
| *SSD* | 4.3±0.83 (<0.001) | 6.2±1.01 (<0.001) | 6.7±1.54 (<0.001) | 5.1±1.09 (<0.001) | 6.4±0.85 (<0.001) | 4.9±1.08 (<0.001) | 5.60 |
| *v, %* | 69.8 | 52.8 | 61.2 | 50.4 | 75.6 | 54.3 | |
| | | | | *U. rossicus* | | | |
| Males | 67.5±1.72 | 17.9±1.40 | 25.1±1.25 | 14.7±1.15 | 21.6±0.83 | 16.4±0.05 | |
| Females | 60.9±0.64 | 16.1±0.39 | 22.7±0.29 | 13.0±0.20 | 18.8±0.23 | 15.4±0.28 | |
| *SSD* | 5.1±1.43 | 5.4±4.29 | 4.8±2.69 | 5.8±4.22 | 6.8±2.13 | 3.0±0.89 | 5.14 |

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | (0.01) | n.s. | n.s. | n.s. | (0.005) | n.s. | |
| *v, %* | 41.6 | - | - | - | 79.6 | - | |
| | | | | *U. k. praekudarensis* | | | |
| Males | 89.4±2.11 | 21.5±0.31 | 33.9±0.52 | 17.3±0.48 | 26.8±0.46 | 23.2±0.71 | |
| Females | 74.2±1.36 | 17.2±0.77 | 26.2±0.75 | 13.8±0.54 | 21.4±0.96 | 19.3±0.63 | |
| *SSD* | 9.3±1.54 | 11.1±2.17 | 12.9±1.53 | 11.3±2.34 | 11.1±2.21 | 9.3±2.24 | 10.83 |
| | (0.01) | (0.004) | (0.04) | (0.008) | (0.008) | (0.02) | |
| *v, %* | 86.3 | 68.6 | 93.7 | 66.2 | 80.4 | 87.4 | |
| | | | | *U. k. kudarensis* | | | |
| Males | 89.4±0.48 | 22.0±0.19 | 35.5±0.29 | 18.3±0.19 | 27.6±0.20 | 23.1±0.16 | |
| Females | 80.2±0.80 | 19.5±0.32 | 30.4±0.58 | 15.1±0.32 | 24.1±0.41 | 21.0±0.33 | |
| *SSD* | 5.4±0.55 | 6.0±0.90 | 4.9±1.01 | 8.8±1.09 | 7.7±0.89 | 5.9±0.82 | 6.26 |
| | (0.009) | (0.01) | (0.02) | n.s. | (0.009) | n.s | |
| *v, %* | 76.2 | 60.8 | 51.0 | - | 69.7 | - | |
| | | | | *U. s. spelaeus* | | | |
| Males | 90.4±1.26 | 23.1±1.44 | 33.9±1.30 | 18.8±0.34 | 27.4±0.64 | - | |
| Females | 77.6±0.60 | 19.5±0.37 | 28.1±0.49 | 15.9±0.29 | 23.7±0.47 | - | |
| *SSD* | 7.6±0.83 | 8.4±3.51 | 9.43±2.25 | 8.4±1.30 | 7.3±1.56 | no data | 8.22 |
| | (0.005) | (0.02) | n.s. | (0.006) | (0.009) | | |
| *v, %* | 93.6 | 38.2 | - | 88.4 | 73.6 | - | |
| | | | | *U. s. ladinicus* | | | |
| Males | 83.7±2.30 | 21.2±0.10 | 33.3±0.90 | 15.8±0.40 | 25.7±0.85 | 21.7±0.75 | |
| Females | 73.6±0.82 | 17.7±0.30 | 27.3±0.34 | 14.2±0.24 | 22.0±0.29 | 18.7±0.21 | |
| *SSD* | 6.4±1.55 | 8.9±0.80 | 9.9±1.59 | 5.4±1.56 | 7.7±1.89 | 7.3±1.94 | 7.60 |
| | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | |
| *v, %* | - | - | - | - | - | - | |
| | | | | *U. s. eremus* | | | |
| Males | 85.4±1.15 | 22.3±0.23 | 33.0±0.46 | 17.7±0.38 | 27.2±0.37 | 22.3±0.34 | |
| Females | 76.5±0.95 | 19.2±0.55 | 28.5±0.38 | 15.2±0.39 | 23.8±0.35 | 19.9±0.31 | |
| *SSD* | 5.5±0.92 | 7.5±1.44 | 7.3±0.98 | 7.5±1.66 | 6.6±0.99 | 5.5±1.09 | 6.66 |
| | (0.004) | (0.003) | (0.003) | (0.003) | (0.003) | (0.004) | |
| *v, %* | 77.5 | 72.6 | 84.4 | 66.4 | 81.2 | 71.0 | |
| | | | | *U. k. ingressus* | | | |
| Males | 88.1±0.96 | 22.8±0.27 | 34.6±0.86 | 19.2±0.25 | 27.7±0.21 | 22.2±0.27 | |
| Females | 82.0±0.76 | 20.0±0.34 | 30.1±0.68 | 16.1±0.21 | 23.5±0.23 | 19.3±0.21 | |
| *SSD* | 3.6±0.72 | 6.6±1.02 | 7.0±1.22 | 8.7±0.94 | 8.2±0.61 | 6.9±0.83 | 6.83 |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | |
| *v, %* | 76.5 | 75.8 | 75.8 | 80.4 | 93.8 | 81.1 | |
| | | | | *U. kanivetz* | | | |
| Males | 85.7±1.99 | 21.1±0.15 | 30.6±1.18 | 16.4±0.29 | 26.1±0.26 | 19.4±1.73 | |
| Females | 75.6±0.67 | 18.7±0.24 | 26.8±0.41 | 15.5±0.30 | 23.1±0.27 | 19.1±0.24 | |
| *SSD* | 6.3±1.31 | 5.9±0.71 | 6.7±2.19 | 3.0±1.32 | 6.1±0.77 | 0.8±4.54 | 4.80 |
| | (0.01) | (0.01) | (0.02) | n.s. | (0.01) | n.s. | |
| *v, %* | 86.6 | 75.7 | 71.3 | - | 81.7 | - | |
| | | | | *U. arctos* | | | |
| Males | 92.5±3.03 | 19.8±0.85 | 29.6±1.34 | 14.9±0.82 | 23.1±0.99 | 19.8±0.64 | |
| Females | 75.9±1.28 | 15.7±0.39 | 23.2±0.60 | 11.2±0.28 | 18.0±0.36 | 16.1±0.47 | |
| *SSD* | 9.9±1.96 | 11.4±2.67 | 12.2±2.81 | 14.2±3.33 | 12.3±2.59 | 10.2±2.2 | 11.70 |
| | (<0.001) | (<0.001) | (0.003) | (<0.001) | (<0.001) | (0.003) | |
| *v, %* | 74.3 | 59.3 | 67.2 | 68.5 | 75.6 | 70.0 | |

## Univariate analysis

Table S17. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtc III. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 2.90 | 4.94 | 0.69 | 3.26 | 1.26 | 1.78 | 0.50 | 3.63 | 3.64 |
| *U. k. praekudarensis* | 2 | 0.04 | | 0.16 | 2.94 | 0.50 | 1.02 | 1.44 | 1.41 | 0.50 | 0.46 |
| *U. k. kudarensis* | 3 | 4.23 | 2.54 | | 3.94 | 0.50 | 1.38 | 2.50 | 1.74 | 1.29 | 0.48 |
| *U. rossicus* | 4 | 3.21 | 2.10 | 6.90 | | 3.26 | 1.61 | 2.00 | 0.91 | 3.20 | 3.49 |
| *U. s. spelaeus* | 5 | 2.06 | 1.38 | 1.32 | 4.52 | | 1.41 | 1.90 | 1.75 | 1.07 | 0.09 |
| *U. k. kanivetz* | 6 | 0.93 | 0.56 | 2.81 | 3.71 | 1.12 | | 0.07 | 0.48 | 0.82 | 1.45 |
| *U. s. eremus* | 7 | 1.48 | 0.98 | 1.89 | 3.98 | 0.49 | 0.60 | | 0.50 | 1.45 | 2.07 |
| *U. s. ladinicus* | 8 | 0.24 | 0.20 | 3.68 | 2.46 | 1.98 | 1.00 | 1.48 | | 1.27 | 1.79 |
| *U. k. ingressus* | 9 | 5.35 | 3.06 | 0.73 | 8.04 | 1.97 | 3.64 | 2.57 | 4.48 | | 1.15 |
| *U. arctos* | 10 | 1.33 | 0.75 | 2.90 | 4.36 | 1.00 | 0.24 | 0.43 | 1.31 | 3.90 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 1.10 | 2.95 | 1.07 | 2.01 | 0.27 | 2.94 | 0.40 | 4.11 | 0.13 |
| *U. k. praekudarensis* | 2 | 1.03 | | 0.87 | 1.66 | 0.94 | 0.52 | 1.35 | 0.29 | 2.07 | 1.09 |
| *U. k. kudarensis* | 3 | 2.39 | 2.62 | | 2.40 | 0.45 | 1.25 | 0.93 | 0.85 | 2.15 | 2.43 |
| *U. rossicus* | 4 | 2.85 | 1.07 | 4.93 | | 2.27 | 1.09 | 2.65 | 1.12 | 3.13 | 0.94 |
| *U. s. spelaeus* | 5 | 1.85 | 2.30 | 0.07 | 4.08 | | 1.28 | 0.15 | 0.98 | 0.68 | 1.94 |
| *U. k. kanivetz* | 6 | 0.75 | 1.51 | 1.39 | 3.28 | 1.09 | | 1.62 | 0.14 | 2.16 | 0.34 |
| *U. s. eremus* | 7 | 1.31 | 1.90 | 0.61 | 3.58 | 0.46 | 0.59 | | 1.21 | 0.73 | 2.64 |
| *U. s. ladinicus* | 8 | 0.73 | 0.40 | 2.71 | 1.79 | 2.25 | 1.32 | 1.77 | | 1.64 | 0.46 |
| *U. k. ingressus* | 9 | 2.51 | 2.79 | 0.59 | 4.68 | 0.57 | 1.71 | 1.03 | 2.83 | | 3.52 |
| *U. arctos* | 10 | 3.51 | 1.29 | 5.92 | 0.19 | 4.67 | 3.89 | 4.12 | 2.16 | 5.34 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 2.65 | 3.72 | 0.82 | 1.87 | 0.20 | 2.28 | 1.43 | 4.34 | 0.26 |
| *U. k. praekudarensis* | 2 | 0.26 | | 0.82 | 2.58 | 0.31 | 1.95 | 1.11 | 0.68 | 0.00 | 2.32 |
| *U. k. kudarensis* | 3 | 4.39 | 2.52 | | 2.59 | 0.28 | 1.86 | 0.70 | 0.19 | 1.64 | 2.76 |
| *U. rossicus* | 4 | 2.69 | 2.06 | 6.58 | | 2.07 | 0.83 | 2.10 | 1.73 | 3.12 | 0.94 |
| *U. s. spelaeus* | 5 | 1.71 | 1.15 | 1.07 | 3.44 | | 1.43 | 0.57 | 0.34 | 0.38 | 1.64 |
| *U. k. kanivetz* | 6 | 0.73 | 0.24 | 3.26 | 3.14 | 1.16 | | 1.31 | 1.06 | 2.52 | 0.01 |
| *U. s. eremus* | 7 | 2.64 | 1.63 | 0.95 | 4.71 | 0.30 | 1.86 | | 0.14 | 1.78 | 1.77 |
| *U. s. ladinicus* | 8 | 1.38 | 0.73 | 2.32 | 3.60 | 0.62 | 0.66 | 1.15 | | 0.82 | 1.22 |
| *U. k. ingressus* | 9 | 3.48 | 2.33 | 0.16 | 5.37 | 1.05 | 2.71 | 0.91 | 2.02 | | 3.49 |
| *U. arctos* | 10 | 2.22 | 1.75 | 6.12 | 0.42 | 3.13 | 2.71 | 4.31 | 3.20 | 5.00 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 1.68 | 4.99 | 0.23 | 3.35 | 0.46 | 2.69 | 0.01 | 5.98 | 0.21 |
| *U. k. praekudarensis* | 2 | 0.49 | | 1.66 | 1.23 | 1.68 | 0.76 | 0.58 | 1.02 | 2.65 | 1.31 |
| *U. k. kudarensis* | 3 | 2.11 | 1.86 | | 2.39 | 0.71 | 2.11 | 1.21 | 2.15 | 2.03 | 3.60 |
| *U. rossicus* | 4 | 1.76 | 0.78 | 3.55 | | 2.42 | 0.51 | 1.68 | 0.17 | 3.01 | 0.34 |
| *U. s. spelaeus* | 5 | 2.96 | 2.61 | 1.29 | 4.12 | | 2.13 | 1.33 | 2.22 | 0.22 | 2.90 |
| *U. k. kanivetz* | 6 | 2.50 | 2.20 | 0.64 | 3.79 | 0.66 | | 1.27 | 0.32 | 2.85 | 0.28 |
| *U. s. eremus* | 7 | 1.81 | 1.76 | 0.14 | 3.08 | 0.98 | 0.40 | | 1.46 | 2.43 | 2.09 |
| *U. s. ladinicus* | 8 | 0.08 | 0.50 | 1.63 | 1.56 | 2.50 | 2.04 | 1.50 | | 2.78 | 0.13 |
| *U. k. ingressus* | 9 | 4.27 | 3.17 | 2.00 | 5.39 | 0.21 | 1.07 | 1.40 | 3.29 | | 4.54 |
| *U. arctos* | 10 | 3.75 | 1.94 | 5.80 | 1.46 | 5.88 | 5.76 | 4.73 | 3.11 | 8.14 | |
| | | | | | Bd | | | | | | |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. deningeri* | 1 | | 1.96 | 4.59 | 0.75 | 2.48 | 0.75 | 2.97 | 0.40 | 4.44 | 0.36 |
| *U. k. praekudarensis* | 2 | 0.14 | | 1.25 | 2.22 | 0.71 | 0.72 | 0.59 | 0.84 | 1.39 | 2.04 |
| *U. k. kudarensis* | 3 | 3.81 | 2.45 | | 3.79 | 0.17 | 1.76 | 0.69 | 1.70 | 0.37 | 3.97 |
| *U. rossicus* | 4 | 2.77 | 1.65 | 6.13 | | 2.67 | 1.21 | 2.93 | 0.86 | 3.81 | 0.39 |
| *U. s. spelaeus* | 5 | 2.44 | 1.85 | 0.48 | 4.46 | | 1.26 | 0.26 | 1.32 | 0.33 | 2.53 |
| *U. k. kanivetz* | 6 | 2.09 | 1.49 | 1.28 | 4.38 | 0.59 | | 1.23 | 0.20 | 1.86 | 0.95 |
| *U. s. eremus* | 7 | 2.79 | 2.06 | 0.25 | 4.84 | 0.21 | 0.84 | | 1.28 | 0.88 | 2.87 |
| *U. s. ladinicus* | 8 | 0.35 | 0.37 | 2.74 | 2.65 | 1.85 | 1.43 | 2.12 | | 1.79 | 0.60 |
| *U. k. ingressus* | 9 | 3.25 | 2.04 | 0.79 | 5.72 | 0.10 | 0.65 | 0.36 | 2.21 | | 3.96 |
| *U. arctos* | 10 | 3.59 | 2.02 | 7.28 | 0.45 | 5.13 | 5.20 | 5.58 | 3.25 | 6.94 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 2.66 | 4.24 | 0.97 | 0.53 | 0.14 | 1.73 | 0.47 | 2.12 | 0.69 |
| *U. k. praekudarensis* | 2 | 0.11 | | 0.02 | 2.64 | 0.82 | 2.13 | 1.25 | 1.31 | 1.29 | 3.00 |
| *U. k. kudarensis* | 3 | 3.42 | 1.99 | | 3.07 | 0.90 | 2.63 | 2.00 | 1.53 | 2.50 | 4.22 |
| *U. rossicus* | 4 | 3.85 | 2.73 | 6.62 | | 1.07 | 0.72 | 1.97 | 1.11 | 2.12 | 0.48 |
| *U. s. spelaeus* | 5 | 1.87 | 1.38 | 0.23 | 4.35 | | 0.57 | 0.21 | 0.16 | 0.25 | 0.85 |
| *U. k. kanivetz* | 6 | 0.03 | 0.08 | 2.85 | 3.43 | 1.72 | | 1.32 | 0.50 | 1.47 | 0.37 |
| *U. s. eremus* | 7 | 1.76 | 1.13 | 0.97 | 4.79 | 0.47 | 1.54 | | 0.53 | 0.11 | 2.19 |
| *U. s. ladinicus* | 8 | 0.77 | 0.62 | 3.57 | 2.66 | 2.25 | 0.71 | 2.19 | | 0.61 | 0.88 |
| *U. k. ingressus* | 9 | 0.52 | 0.23 | 2.68 | 4.11 | 1.49 | 0.41 | 1.26 | 1.17 | | 2.53 |
| *U. arctos* | 10 | 3.50 | 2.43 | 6.43 | 0.48 | 4.09 | 3.09 | 4.51 | 2.30 | 3.78 | |

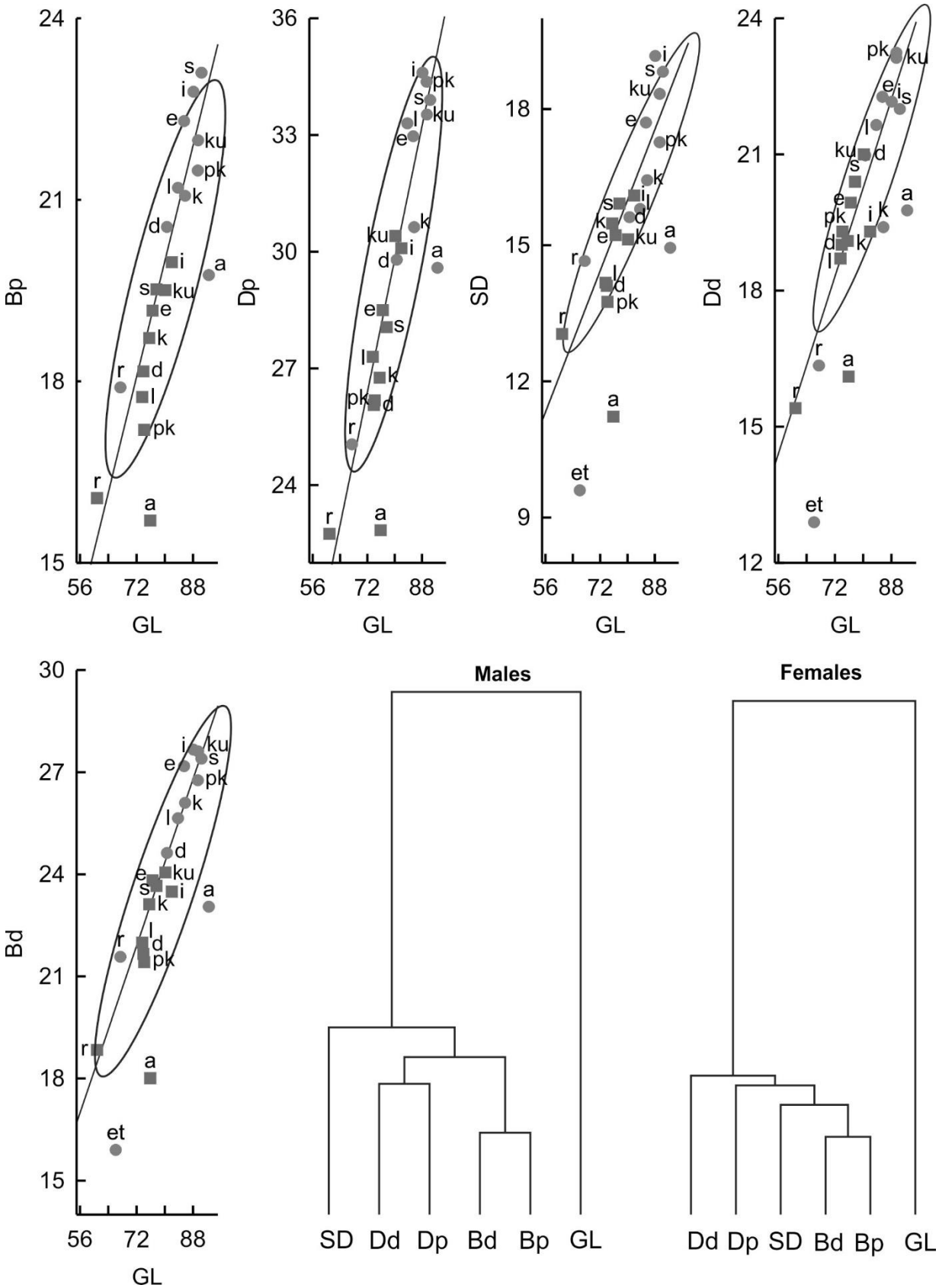


Fig. S11. The scatterplots of length of mtc III and the other measures (Bp – Dd) and Relationships between measures of mtc II (single linkage, correlation distances used): et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. The dashed lines are lines of regressions and ellipses' horizontal and vertical projections onto the axes are equal to the "sample mean ± "sample range" x 0.95.

Table S18. Statistical parameters of measures of mtc III among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | Std.Dev. | BP - N | BP | Std.Dev. | Dp- N | Dp | Std.Dev. | SD - N | SD | Std.Dev. | Bd - N | Bd | Std.Dev. | Dd- N | Dd | Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | f | 1 | 66.1 | | | | | | | | 1 | 9.6 | | 1 | 15.9 | 0.00 | 1 | 12.9 | |
| *U. rossicus* | m | 4 | 67.5 | 3.43 | 2 | 17.9 | 1.98 | 2 | 25.1 | 1.77 | 2 | 14.7 | 1.63 | 4 | 21.6 | 1.65 | 2 | 16.4 | 0.07 |
| | f | 15 | 60.9 | 2.48 | 13 | 16.1 | 1.42 | 13 | 22.7 | 1.03 | 13 | 13.0 | 0.72 | 15 | 18.8 | 0.91 | 11 | 15.4 | 0.93 |
| *U. deningeri* | m | 11 | 80.6 | 3.57 | 13 | 20.6 | 1.27 | 11 | 29.8 | 2.51 | 13 | 15.6 | 0.85 | 11 | 24.6 | 1.05 | 10 | 21.0 | 1.14 |
| | f | 22 | 73.5 | 2.90 | 21 | 18.2 | 1.39 | 20 | 26.1 | 1.83 | 22 | 14.2 | 1.03 | 22 | 21.7 | 1.16 | 21 | 19.0 | 1.13 |
| *U. k. praekudar.* | m | 5 | 89.4 | 4.73 | 6 | 21.5 | 0.77 | 3 | 34.4 | 0.97 | 6 | 17.3 | 1.18 | 6 | 26.8 | 1.13 | 5 | 23.2 | 1.58 |
| | f | 5 | 74.2 | 3.04 | 6 | 17.2 | 1.89 | 5 | 26.2 | 1.68 | 6 | 13.8 | 1.32 | 5 | 21.4 | 2.14 | 5 | 19.3 | 1.41 |
| *U. k. kudarensis* | m | 52 | 89.4 | 3.46 | 51 | 22.0 | 1.38 | 50 | 33.5 | 2.05 | 53 | 18.3 | 1.28 | 48 | 27.6 | 1.41 | 50 | 23.1 | 1.11 |
| | f | 20 | 80.2 | 3.58 | 21 | 19.5 | 1.46 | 20 | 30.4 | 2.58 | 22 | 15.1 | 1.49 | 21 | 24.1 | 1.89 | 21 | 21.0 | 1.50 |
| *U. s. spelaeus* | m | 4 | 90.4 | 2.52 | 4 | 23.1 | 2.89 | 2 | 33.9 | 1.84 | 4 | 18.8 | 0.68 | 4 | 27.4 | 1.28 | 1 | 22.0 | 0.00 |
| | f | 10 | 77.6 | 1.91 | 10 | 19.5 | 1.18 | 5 | 28.1 | 1.10 | 10 | 15.9 | 0.93 | 9 | 23.7 | 1.42 | 5 | 20.4 | 1.03 |
| *U. k. kanivetz* | m | 3 | 85.7 | 3.45 | 3 | 21.1 | 0.25 | 3 | 30.6 | 2.05 | 3 | 16.4 | 0.50 | 3 | 26.1 | 0.46 | 3 | 19.4 | 3.00 |
| | f | 14 | 75.6 | 2.51 | 14 | 18.7 | 0.91 | 14 | 26.8 | 1.52 | 14 | 15.5 | 1.13 | 14 | 23.1 | 1.00 | 12 | 19.1 | 0.84 |
| *U. s. eremus* | m | 10 | 85.4 | 3.64 | 10 | 22.3 | 0.72 | 10 | 33.0 | 1.46 | 10 | 17.7 | 1.20 | 10 | 27.2 | 1.16 | 10 | 22.3 | 1.09 |
| | f | 10 | 76.5 | 3.01 | 10 | 19.2 | 1.74 | 10 | 28.5 | 1.22 | 10 | 15.2 | 1.24 | 10 | 23.8 | 1.10 | 10 | 19.9 | 0.97 |
| *U. s. ladinicus* | m | 2 | 83.7 | 3.25 | 2 | 21.2 | 0.14 | 2 | 33.3 | 1.27 | 2 | 15.8 | 0.57 | 2 | 25.7 | 1.20 | 2 | 21.7 | 1.06 |
| | f | 11 | 73.6 | 2.70 | 11 | 17.7 | 0.98 | 11 | 27.3 | 1.11 | 11 | 14.2 | 0.80 | 11 | 22.0 | 0.96 | 11 | 18.7 | 0.71 |
| *U. k. ingressus* | m | 24 | 88.1 | 4.72 | 16 | 22.8 | 1.07 | 15 | 34.6 | 1.50 | 26 | 19.2 | 1.30 | 23 | 27.7 | 1.03 | 21 | 22.2 | 1.24 |
| | f | 28 | 82.0 | 4.02 | 10 | 20.0 | 1.08 | 8 | 30.1 | 1.93 | 28 | 16.1 | 1.10 | 27 | 23.5 | 1.17 | 17 | 19.3 | 0.87 |
| *U. arctos* | m | 6 | 92.5 | 7.43 | 7 | 19.8 | 2.26 | 7 | 29.6 | 3.56 | 7 | 14.9 | 2.16 | 6 | 23.1 | 2.44 | 6 | 19.8 | 1.56 |
| | f | 23 | 76.1 | 6.00 | 22 | 15.7 | 1.84 | 13 | 22.8 | 2.78 | 23 | 11.3 | 1.31 | 23 | 18.1 | 1.71 | 14 | 16.3 | 1.72 |

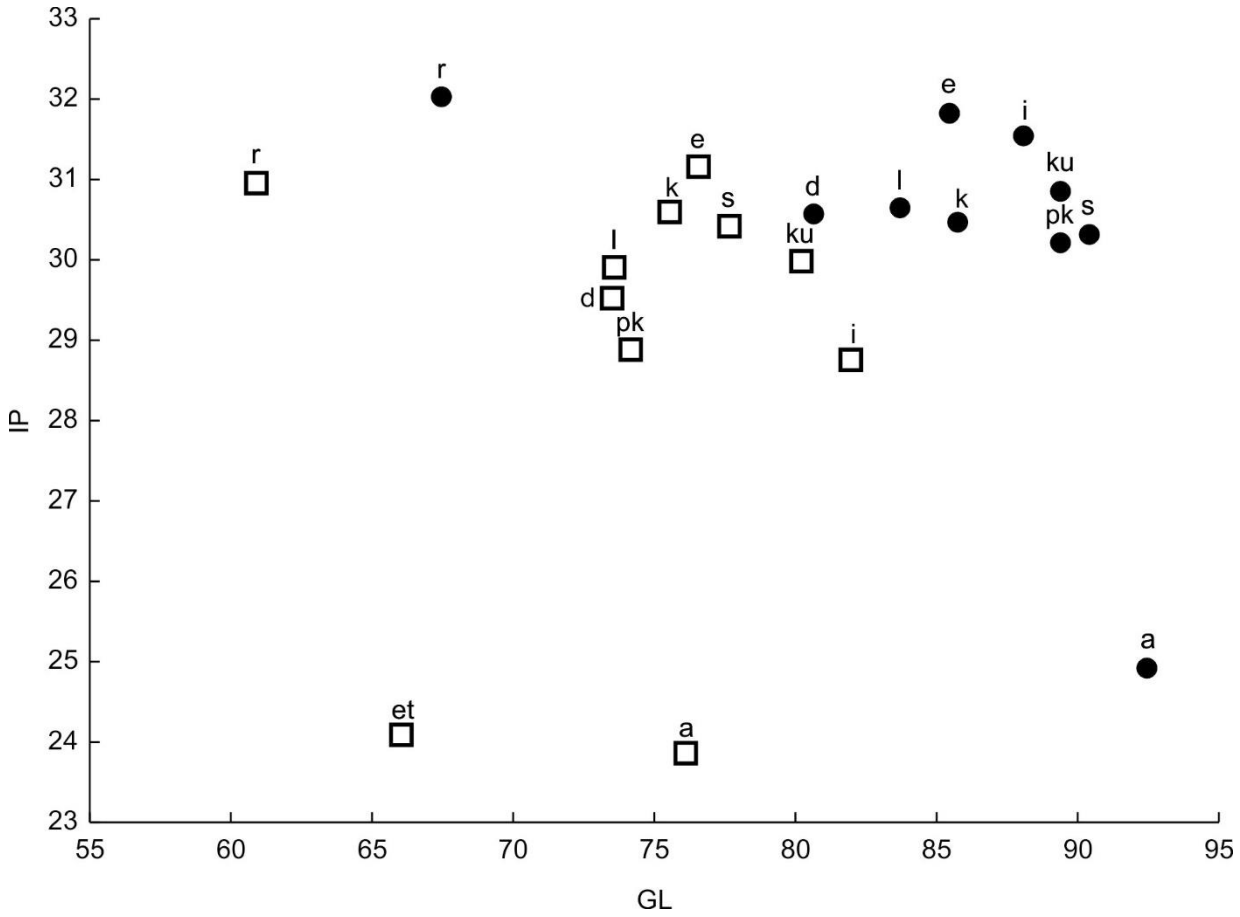


Fig. S12. The scatterplot of Index plumpness (ip) and GL of mtc III: a – *U. arctos*, r – *U. rossicus*, sa – *U. savini*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females.

## Multivariate analysis

Table S19. Description of the modeled morphological spaces for cave bears and brown bear mtc III. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | K3 | |
| GL | 0.95 | 0.56 | -0.13 | 0.49 | 0.96 | 0.95 | 0.16 | -0.5 | -0.25 | 0.28 | 0.97 |
| Bp | 0.91 | 0.24 | 0.07 | 0.32 | 0.87 | 0.92 | 0.04 | -0.42 | -0.1 | -0.1 | 0.89 |
| Dp | 0.96 | 0.44 | 0.09 | 0.46 | 0.94 | 0.96 | 0.22 | -0.6 | -0.42 | -0.08 | 0.97 |
| SD | 0.92 | 0.12 | 0.01 | 0.09 | 0.96 | 0.92 | -0.22 | -0.15 | -0.37 | -0.01 | 0.98 |
| Bd | 0.97 | 0.25 | 0.05 | 0.3 | 0.97 | 0.97 | -0.02 | -0.37 | -0.31 | -0.03 | 0.97 |
| Dd | 0.95 | 0.51 | 0.15 | 0.53 | 0.94 | 0.95 | 0.34 | -0.58 | -0.11 | 0.05 | 0.95 |
| ip | 0.30 | -0.65 | 0.54 | -0.26 | 0.87 | 0.29 | -0.25 | 0.19 | 0.04 | -0.70 | 0.69 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 59.4 | 31.9 | 17.6 | 36.8 | | 59.8 | 29.3 | 37.4 | 39.5 | 9.6 | |

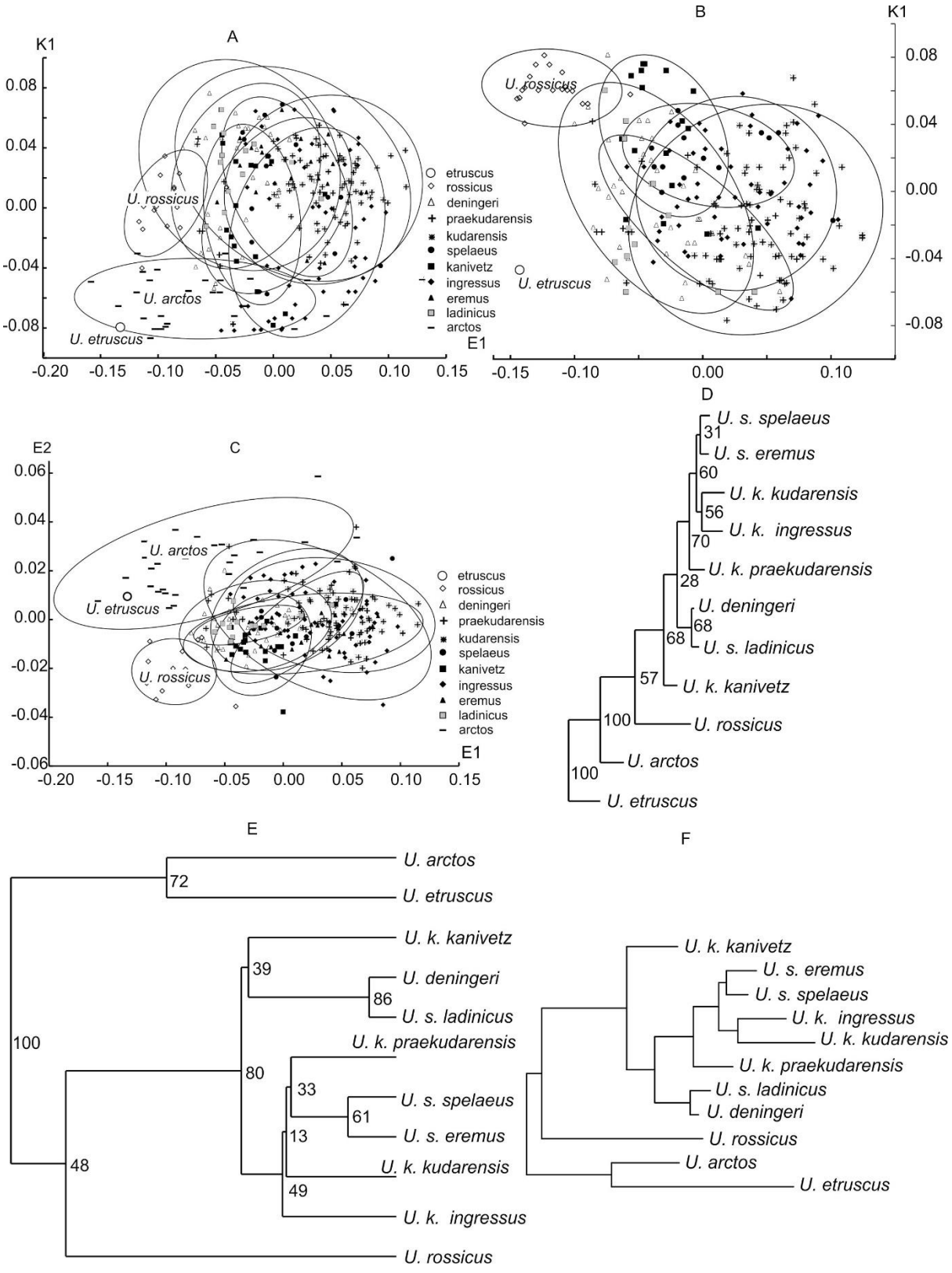


Fig. S13. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc III in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (ctntroid) ± "sample range" x 0.95.

## Males

Table S20. Description of the modeled morphological spaces for males of cave bears and brown bear mtc III. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | "Shape" morphospace | | | $r^2$ | "Size" morphospace | "Shape" morphospace | | | $r^2$ |
| | E1 | K1 | K2 | K3 | | E1 | K1 | K2 | K3 | |
| GL | 0.70 | -0.35 | 0.06 | 0.53 | 0.84 | 0.88 | -0.26 | 0.08 | -0.61 | 0.95 |
| Bp | 0.83 | -0.20 | -0.43 | -0.27 | 0.78 | 0.79 | -0.29 | -0.10 | 0.08 | 0.75 |
| Dp | 0.94 | -0.42 | -0.60 | 0.11 | 0.96 | 0.94 | -0.57 | -0.38 | -0.27 | 0.96 |
| SD | 0.84 | 0.19 | -0.48 | 0.03 | 0.92 | 0.83 | 0.08 | -0.39 | -0.27 | 0.93 |
| Bd | 0.90 | 0.03 | -0.49 | -0.07 | 0.89 | 0.89 | -0.08 | -0.26 | -0.17 | 0.89 |
| Dd | 0.89 | -0.45 | -0.37 | -0.10 | 0.87 | 0.87 | -0.57 | -0.06 | -0.13 | 0.88 |
| ip | 0.20 | 0.37 | -0.44 | -0.53 | 0.72 | 0.19 | 0.22 | -0.40 | 0.64 | 0.67 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 75.1 | 25.3 | 36.9 | 28.2 | | 77.2 | 22.6 | 33.9 | 19.2 | |

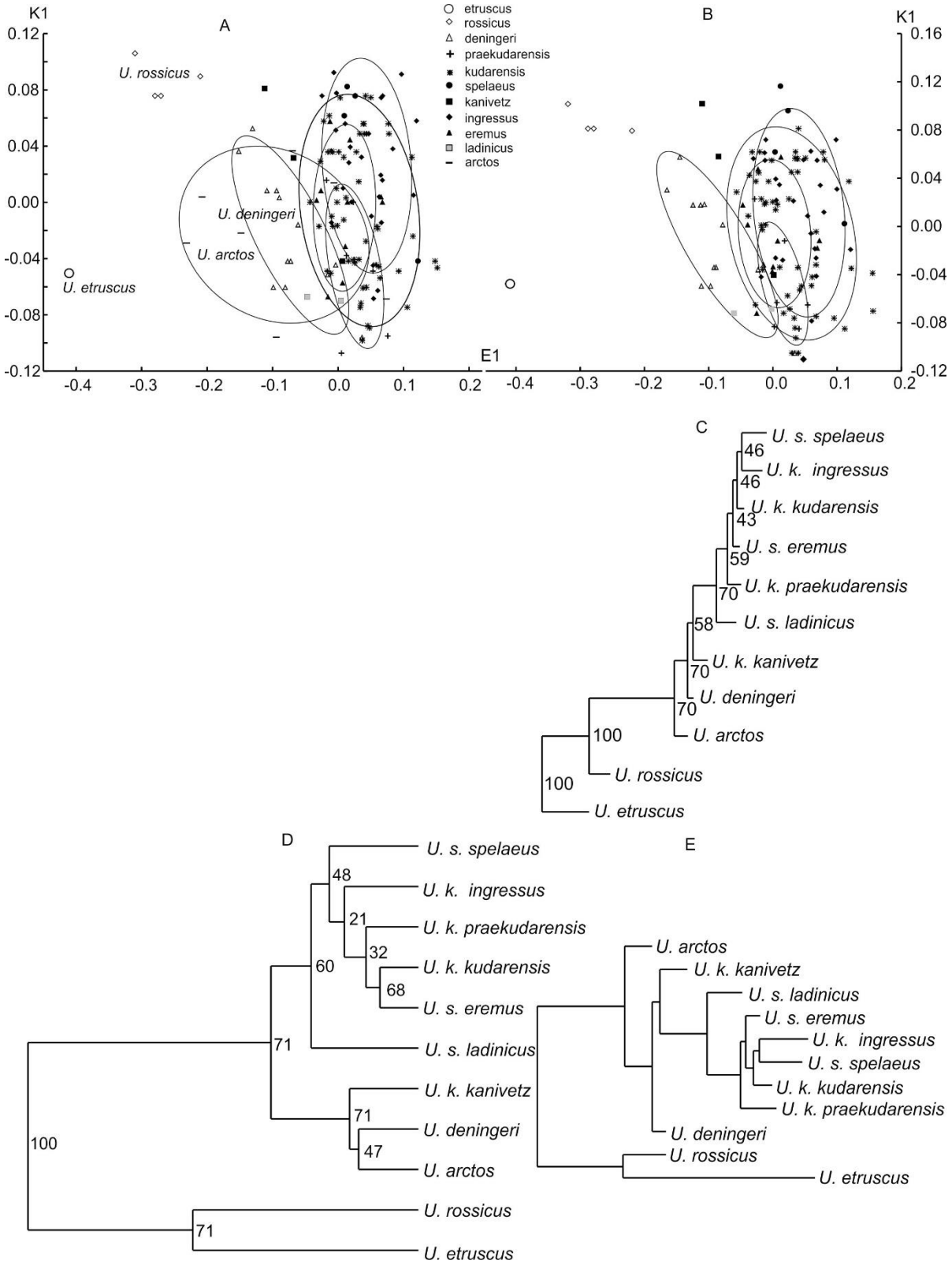


Fig. S14. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc III in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S21. Description of the modeled morphological spaces for females of cave bears and brown bear mtc III. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morpho-space | "Shape" morphospace | | | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | K1 | K2 | K3 | K4 | |
| GL | 0.71 | 0.53 | -0.20 | -0.41 | 0.94 | 0.88 | -0.18 | -0.06 | 0.24 | -0.03 | 0.89 |
| Bp | 0.89 | -0.20 | 0.31 | -0.28 | 0.82 | 0.85 | -0.02 | -0.44 | -0.21 | 0.37 | 0.94 |
| Dp | 0.93 | -0.10 | 0.33 | -0.44 | 0.86 | 0.90 | -0.20 | 0.10 | 0.25 | 0.44 | 0.95 |
| SD | 0.88 | -0.49 | 0.67 | -0.09 | 0.94 | 0.85 | 0.44 | -0.26 | 0.34 | 0.14 | 0.94 |
| Bd | 0.96 | -0.31 | 0.53 | -0.36 | 0.95 | 0.95 | 0.05 | -0.21 | 0.45 | 0.27 | 0.96 |
| Dd | 0.95 | -0.08 | 0.33 | -0.60 | 0.95 | 0.92 | -0.24 | -0.18 | 0.25 | 0.07 | 0.92 |
| ip | 0.08 | -0.73 | 0.72 | -0.18 | 0.89 | 0.09 | 0.13 | -0.49 | 0.53 | 0.51 | 0.78 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 74.8 | 65.9 | 54.8 | 46.5 | | 71.2 | 37.4 | 20.1 | 5.7 | 10.7 | |

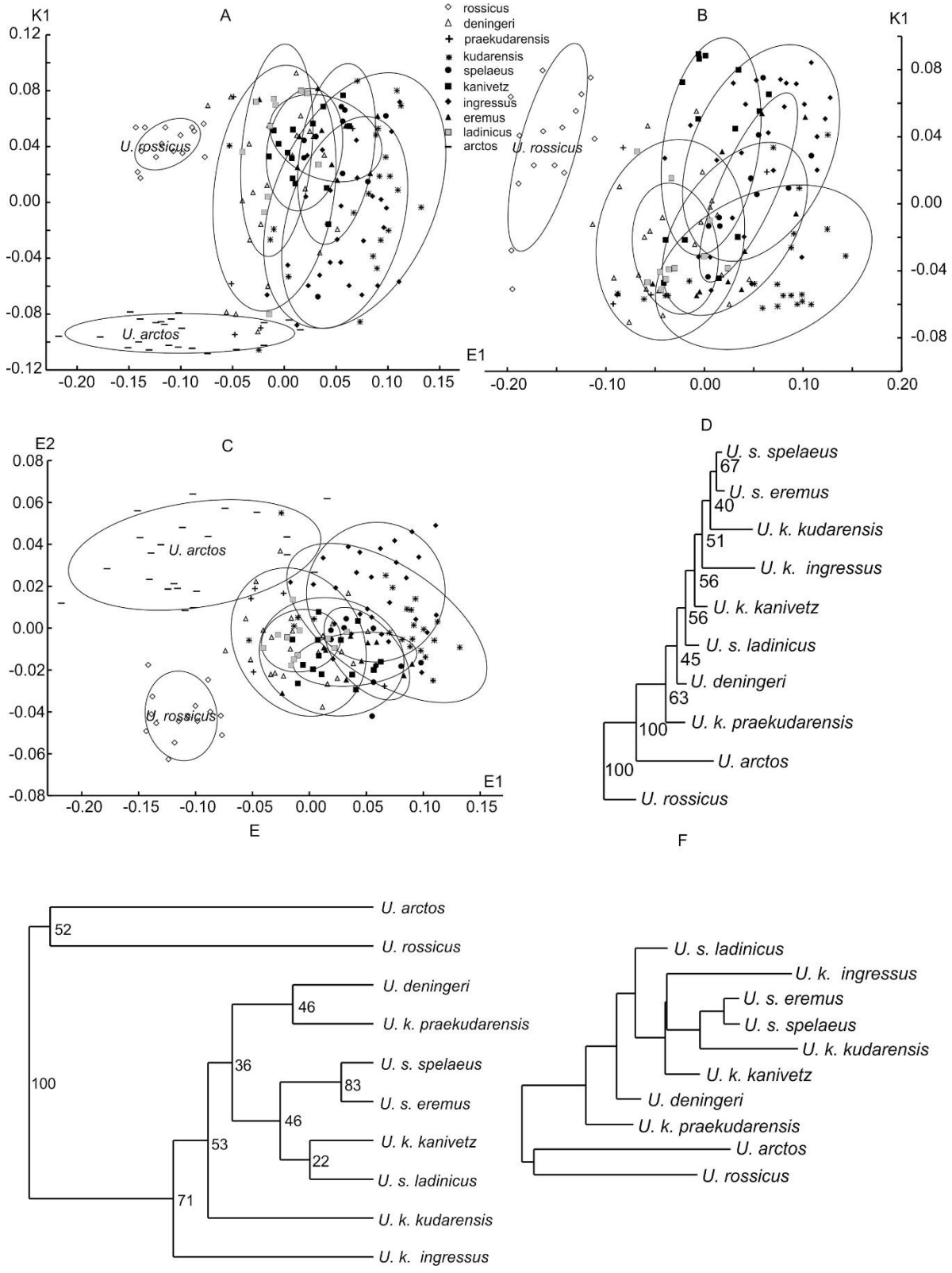


Fig. S15. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc III in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METACARPAL BONE IV (MTC IV)

## Males and females

Table S22. Sample numbers (N), means (M), and standard errors (m) of the variables of mtc IV among the different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. deningeri* | 37 | 79.4±0.93 | 37 | 21.0±0.33 | 37 | 29.2±0.47 | 37 | 16.3±0.22 |
| *U. k. praekudarensis* | 6 | 82.4±3.45 | 8 | 18.2±0.89 | 6 | 29.1±1.58 | 8 | 14.9±0.71 |
| *U. k. kudarensis* | 48 | 89.9±0.98 | 53 | 24.1±0.32 | 51 | 34.1±0.46 | 54 | 18.4±0.26 |
| *U. rossicus* | 26 | 63.2±0.70 | 20 | 17.1±0.23 | 19 | 23.3±0.35 | 20 | 14.0±0.24 |
| *U. s. spelaeus* | 28 | 81.4±0.98 | 27 | 21.7±0.30 | 24 | 30.1±0.47 | 28 | 17.4±0.30 |
| *U. k. kanivetz* | 18 | 80.1±1.30 | 18 | 21.1±0.46 | 17 | 29.4±0.71 | 18 | 17.8±0.30 |
| *U. s. eremus* | 20 | 82.6±1.01 | 20 | 22.2±0.33 | 20 | 32.4±0.44 | 20 | 16.8±0.31 |
| *U. s. ladinicus* | 10 | 77.0±1.39 | 10 | 21.2±0.39 | 10 | 30.2±0.59 | 10 | 16.0±0.33 |
| *U. k. ingressus* | 45 | 88.5±0.71 | 14 | 24.3±0.59 | 11 | 35.6±0.76 | 47 | 18.5±0.23 |
| *U. arctos* | 27 | 80.5±1.87 | 27 | 17.6±0.58 | 21 | 24.5±0.78 | 27 | 12.6±0.38 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. deningeri* | 36 | 24.9±0.35 | 36 | 20.8±0.23 |
| *U. k. praekudarensis* | 7 | 24.3±1.28 | 5 | 21.3±1.31 |
| *U. k. kudarensis* | 51 | 28.1±0.40 | 46 | 22.9±0.28 |
| *U. rossicus* | 26 | 20.2±0.23 | 17 | 16.0±0.27 |
| *U. s. spelaeus* | 28 | 25.3±0.40 | 18 | 20.6±0.28 |
| *U. k. kanivetz* | 18 | 25.8±0.50 | 10 | 21.0±0.44 |
| *U. s. eremus* | 20 | 26.0±0.48 | 20 | 21.3±0.37 |
| *U. s. ladinicus* | 10 | 24.2±0.54 | 10 | 20.0±0.36 |
| *U. k. ingressus* | 45 | 27.2±0.37 | 30 | 22.8±0.20 |
| *U. arctos* | 27 | 19.2±0.54 | 21 | 17.4±0.52 |

### Sexual dimorphism

Table S23. Sexual size dimorphism (SSD and ASSD) of mtc IV in the different forms of cave bears and brown bear; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 85.8±1.11 | 22.5±0.49 | 31.7±0.43 | 17.6±0.24 | 26.6±0.36 | 22.1±0.25 | |
| Females | 76.0±0.54 | 20.2±0.33 | 27.8±0.56 | 15.5±0.19 | 24.0±0.39 | 20.0±0.20 | |
| *SSD* | 6.0±0.76 | 5.5±1.38 | 6.5±1.10 | 6.3±0.92 | 5.0±1.06 | 5.0±0.76 | |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | 5.74 |
| *v*, % | 81.8 | 47.4 | 59.0 | 71.3 | 51.1 | 71.2 | |
| | | | | *U. rossicus* | | | |
| Males | 66.4±0.82 | 17.8±0.24 | 24.4±0.28 | 14.6±0.39 | 21.0±0.22 | 16.8±0.31 | |
| Females | 60.9±0.51 | 16.6±0.25 | 22.6±0.24 | 13.6±0.25 | 16.8±0.28 | 15.4±0.30 | |
| *SSD* | 4.3±0.76 | 3.5±1.00 | 3.9±0.78 | 3.6±1.63 | 3.5±0.87 | 4.1±1.33 | |
| | (<0.001) | (0.005) | (<0.001) | (0.03) | (0.002) | (0.01) | 3.83 |
| *v*, % | 66.5 | 50.7 | 75.1 | 48.0 | 44.6 | 57.5 | |
| | | | | *U. k. praekudarensis* | | | |

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| Males | 89.0±3.84 | 20.9±0.35 | 34.0±0.65 | 16.7±0.64 | 27.4±0.62 | 24.3±0.70 | |
| Females | 75.7±0.70 | 16.6±0.63 | 16.7±0.64 | 13.8±0.71 | 22.0±1.16 | 19.6±1.05 | |
| *SSD* | 8.1±2.37 | 11.6±1.93 | 11.9±1.46 | 9.5±3.13 | 11.0±2.68 | 10.7±2.9 | |
| | n.s. | (0.035) | n.s. | n.s | n.s. | n.s. | 10.47 |
| *v, %* | - | 68.2 | - | - | - | | |
| | | | | *U. k. kudarensis* | | | |
| Males | 93.4±0.77 | 24.9±0.32 | 35.4±0.43 | 19.1±0.25 | 29.2±0.40 | 23.7±0.25 | |
| Females | 83.4±1.36 | 22.7±0.55 | 31.7±0.77 | 17.2±0.44 | 26.3±0.63 | 21.6±0.46 | |
| *SSD* | 5.6±0.88 | 4.7±1.33 | 5.6±1.32 | 5.3±1.40 | 5.4±1.36 | 4.6±1.16 | |
| | (<0.001) | (0.002) | (<0.001) | (0.002) | (<0.001) | (<0.001) | 5.20 |
| *v, %* | 66.8 | 39.8 | 54.3 | 43.4 | 48.1 | 50.7 | |
| | | | | *U. s. spelaeus* | | | |
| Males | 89.9±1.24 | 23.4±0.78 | 32.5±0.71 | 19.9±0.65 | 28.2±0.88 | 22.0±0.64 | |
| Females | 79.4±0.52 | 21.2±0.22 | 29.3±0.43 | 16.8±0.18 | 24.5±0.28 | 20.4±0.27 | |
| *SSD* | 6.4±0.79 | 4.9±1.83 | 5.3±1.34 | 8.1±1.85 | 6.9±1.75 | 3.9±1.63 | |
| | (<0.001) | (0.01) | (0.004) | (<0.001) | (<0.001) | n.s. | 5.93 |
| *v, %* | 92.3 | 50.5 | 55.0 | 86.6 | 83.4 | - | |
| | | | | *U. s. ladinicus* | | | |
| Males | 80.5±1.23 | 21.5±0.38 | 31.2±1.00 | 16.4±0.35 | 25.4±0.39 | 20.4±0.41 | |
| Females | 73.5±0.97 | 20.8±0.69 | 29.2±0.21 | 15.5±0.52 | 23.4±0.82 | 19.6±0.59 | |
| *SSD* | 4.6±1.02 | 1.7±1.87 | 3.3±1.7 | 2.8±1.97 | 4.1±1.86 | 2.0±1.79 | |
| | (0.01) | n.s. | n.s. | n.s. | n.s. | n.s. | 3.09 |
| *v, %* | 79.3 | - | - | - | - | - | |
| | | | | *U. s. eremus* | | | |
| Males | 86.6±0.89 | 23.3±0.38 | 34.1±0.32 | 17.8±0.32 | 28.0±0.38 | 22.7±0.36 | |
| Females | 79.3±0.73 | 21.3±0.30 | 31.0±0.44 | 15.9±0.31 | 24.4±0.35 | 20.2±0.32 | |
| *SSD* | 4.4±0.72 | 4.5±1.09 | 4.7±0.84 | 5.8±1.31 | 6.8±0.99 | 5.8±1.13 | |
| | (<0.001) | (0.003) | (<0.001) | (0.003) | (<0.001) | (<0.001) | 5.34 |
| *v, %* | 78.9 | 62.6 | 73.5 | 65.2 | 82.4 | 72.5 | |
| | | | | *U. k. ingressus* | | | |
| Males | 90.9±1.01 | 25.5±0.46 | 36.4±0.86 | 20.4±0.27 | 30.1±0.42 | 23.3±0.26 | |
| Females | 87.4±0.87 | 22.2±0.84 | 33.5±0.58 | 17.7±0.18 | 25.9±0.28 | 22.4±0.26 | |
| *SSD* | 1.9±0.75 | 6.9±2.02 | 4.2±1.49 | 7.1±0.85 | 7.4±0.90 | 1.9±0.80 | |
| | n.s. | (0.01) | n.s. | (<0.001) | (<0.001) | (0.04) | 4.91 |
| *v, %* | - | 52.5 | - | 90.8 | 87.9 | 19.6 | |
| | | | | *U. k. kanivetz* | | | |
| Males | 87.6±0.72 | 23.9±0.48 | 32.8±0.59 | 19.4±0.27 | 28.4±0.61 | 22.2±0.70 | |
| Females | 77.2±0.84 | 20.1±0.21 | 28.0±0.60 | 17.2±0.23 | 24.8±0.38 | 20.2±0.26 | |
| *SSD* | 6.3±0.67 | 8.7±1.20 | 8.0±1.39 | 6.0±0.96 | 6.7±1.35 | 4.7±1.77 | |
| | (0.002) | (0.002) | (0.003) | (0.002) | (0.002) | (0.04) | 6.74 |
| *v, %* | 93.3 | 92.7 | 78.4 | 86.2 | 81.9 | 64.0 | |
| | | | | *U. arctos* | | | |
| Males | 89.1±3.0 | 20.5±0.89 | 28.0±0.85 | 14.3±0.61 | 22.5±0.80 | 19.4±0.55 | |
| Females | 75.5±1.36 | 16.0±0.38 | 22.6±0.47 | 11.6±0.29 | 18.3±0.35 | 16.1±0.30 | |
| *SSD* | 8.2±2.01 | 12.2±2.67 | 10.8±1.92 | 10.4±2.63 | 10.2±2.15 | 9.0±1.79 | |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (0.003) | 10.15 |
| *v, %* | 54.8 | 65.9 | 75.5 | 69.4 | 71.5 | 74.1 | |

## Univariate analysis

Table S24. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtc IV. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 0.76 | 4.14 | 2.56 | 1.64 | 0.63 | 2.52 | 0.08 | 1.33 | 0.99 |
| *U. k. praekudarensis* | 2 | 0.24 | | 1.46 | 2.36 | 0.45 | 0.21 | 0.75 | 0.68 | 1.63 | 0.11 |
| *U. k. kudarensis* | 3 | 3.60 | 2.06 | | 6.89 | 1.26 | 2.15 | 1.24 | 3.53 | 4.29 | 2.62 |
| *U. rossicus* | 4 | 3.32 | 1.49 | 6.30 | | 3.66 | 2.56 | 5.00 | 2.41 | 0.65 | 3.35 |
| *U. s. spelaeus* | 5 | 2.04 | 1.22 | 1.67 | 5.06 | | 0.79 | 0.33 | 1.47 | 2.49 | 0.76 |
| *U. k. kanivetz* | 6 | 0.70 | 0.61 | 2.44 | 3.52 | 1.03 | | 1.22 | 0.53 | 1.63 | 0.16 |
| *U. k. ingressus* | 7 | *6.07* | 2.98 | 1.69 | 8.72 | 3.76 | 4.26 | | 2.19 | 3.20 | 1.33 |
| *U. s. eremus* | 8 | 1.85 | 1.26 | 1.20 | 4.45 | 0.20 | 1.06 | 2.78 | | 1.31 | 0.83 |
| *U. s. ladinicus* | 9 | 1.06 | 0.51 | *3.27* | 1.10 | 2.27 | 1.45 | 4.51 | 2.22 | | 2.04 |
| *U. arctos* | 10 | 0.12 | 0.18 | *3.44* | 2.98 | 1.99 | 0.76 | 5.59 | 1.84 | 0.95 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 1.07 | 3.05 | 2.73 | 0.73 | 1.01 | 2.93 | 0.60 | 0.94 | 1.38 |
| *U. k. praekudarensis* | 2 | 2.57 | | 2.79 | 0.80 | 1.48 | 1.67 | 2.94 | 1.41 | 0.26 | 0.16 |
| *U. k. kudarensis* | 3 | 3.27 | 4.51 | | 5.64 | 1.44 | 0.97 | 0.73 | 1.97 | 3.11 | 4.38 |
| *U. rossicus* | 4 | 3.40 | 0.12 | 6.00 | | 2.93 | 3.08 | 5.14 | 3.05 | 1.28 | 1.36 |
| *U. s. spelaeus* | 5 | 1.77 | 3.61 | 1.47 | 4.79 | | 0.29 | 1.73 | 0.19 | 1.41 | 1.82 |
| *U. k. kanivetz* | 6 | 0.24 | 2.24 | 3.01 | 2.79 | 1.74 | | 1.33 | 0.49 | 1.62 | 2.03 |
| *U. k. ingressus* | 7 | 1.65 | 3.28 | 0.36 | 3.78 | 0.56 | 1.70 | | 2.15 | 3.17 | 4.03 |
| *U. s. eremus* | 8 | 1.56 | 3.40 | 1.12 | 4.24 | 0.10 | 1.59 | 0.45 | | 1.35 | 1.83 |
| *U. s. ladinicus* | 9 | 0.61 | 2.47 | 1.38 | 2.82 | 0.46 | 0.73 | 0.80 | 0.50 | | 0.16 |
| *U. arctos* | 10 | 4.14 | 0.10 | 6.98 | 0.30 | 5.65 | 3.34 | 4.17 | 4.86 | 3.17 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 1.06 | 4.00 | 2.15 | 0.53 | 0.66 | 3.68 | 2.00 | 0.13 | 1.49 |
| *U. k. praekudarensis* | 2 | 0.62 | | 0.69 | 2.26 | 0.67 | 0.55 | 1.07 | 0.08 | 1.05 | 1.86 |
| *U. k. kudarensis* | 3 | 3.37 | 2.50 | | 5.57 | 2.36 | 2.00 | 0.88 | 1.18 | 2.87 | 5.20 |
| *U. rossicus* | 4 | 3.44 | 1.53 | 6.08 | | 2.28 | 2.32 | 5.14 | 3.72 | 1.60 | 0.72 |
| *U. s. spelaeus* | 5 | 1.49 | 1.44 | 1.76 | 4.51 | | 0.15 | 2.58 | 1.15 | 0.54 | 1.72 |
| *U. k. kanivetz* | 6 | 0.16 | 0.67 | 2.67 | 3.12 | 1.09 | | 2.29 | 0.93 | 0.66 | 1.78 |
| *U. k. ingressus* | 7 | 2.55 | 2.48 | 0.82 | 4.31 | 1.76 | 2.33 | | 1.62 | 3.02 | 4.73 |
| *U. s. eremus* | 8 | 2.77 | 2.30 | 0.11 | 5.33 | 1.42 | 2.28 | 0.85 | | 1.68 | 3.21 |
| *U. s. ladinicus* | 9 | 0.94 | 1.19 | 1.16 | 3.16 | 0.00 | 0.77 | 1.50 | 1.01 | | 1.03 |
| *U. arctos* | 10 | 3.50 | 1.57 | 6.14 | 0.05 | 4.57 | 3.17 | 4.34 | 5.38 | 3.20 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 0.65 | 2.44 | 2.19 | 2.29 | 2.15 | 3.99 | 0.28 | 1.07 | 2.29 |
| *U. k. praekudarensis* | 2 | 1.21 | | 2.01 | 0.84 | 2.18 | 2.12 | 3.07 | 0.81 | 0.20 | 0.83 |
| *U. k. kudarensis* | 3 | 3.31 | 3.19 | | 4.53 | 0.75 | 0.70 | 2.33 | 1.80 | 2.84 | 4.89 |
| *U. rossicus* | 4 | 2.06 | 0.25 | 4.74 | | 3.91 | 3.71 | 5.68 | 2.27 | 0.74 | 0.04 |
| *U. s. spelaeus* | 5 | 2.54 | 2.71 | 0.82 | 4.12 | | 0.00 | 0.84 | 1.91 | 2.79 | 4.05 |
| *U. k. kanivetz* | 6 | 2.95 | 3.06 | 0.04 | 4.36 | 0.76 | | 0.78 | 1.81 | 2.67 | 3.82 |
| *U. k. ingressus* | 7 | 4.84 | 3.95 | 1.05 | 6.02 | 2.00 | 0.87 | | 3.31 | 4.03 | 6.04 |
| *U. s. eremus* | 8 | 0.48 | 1.43 | 2.20 | 2.16 | 1.56 | 2.05 | 3.23 | | 1.22 | 2.36 |
| *U. s. ladinicus* | 9 | 0.04 | 0.97 | 1.96 | 1.41 | 1.47 | 1.89 | 2.66 | 0.28 | | 0.73 |
| *U. arctos* | 10 | 3.52 | 1.03 | 6.42 | 1.03 | 5.78 | 5.79 | 8.10 | 3.34 | 2.24 | |
| | | | | | Bd | | | | | | |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. deningeri* | 1 | | 0.45 | 3.12 | 2.52 | 1.43 | 1.55 | 3.74 | 1.40 | 0.79 | 1.90 |
| *U. k. praekudarensis* | 2 | 1.05 | | 1.22 | 2.03 | 0.59 | 0.72 | 1.81 | 0.48 | 0.96 | 1.65 |
| *U. k. kudarensis* | 3 | 3.04 | 2.75 | | 5.89 | 0.72 | 0.43 | 1.29 | 1.11 | 3.00 | 5.04 |
| *U. rossicus* | 4 | 3.59 | 1.10 | 6.17 | | 3.42 | 3.43 | 6.14 | 3.65 | 1.15 | 0.54 |
| *U. s. spelaeus* | 5 | 0.76 | 1.47 | 2.28 | 4.23 | | 0.19 | 1.51 | 0.19 | 1.85 | 2.91 |
| *U. k. kanivetz* | 6 | 1.06 | 1.64 | 1.59 | 4.11 | 0.41 | | 1.19 | 0.38 | 1.95 | 2.95 |
| *U. k. ingressus* | 7 | 3.21 | 2.74 | 0.20 | 6.59 | 2.36 | 1.56 | | 1.95 | 3.56 | 5.40 |
| *U. s. eremus* | 8 | 0.40 | 1.23 | 2.09 | 3.37 | 0.21 | 0.54 | 2.10 | | 1.83 | 3.06 |
| *U. s. ladinicus* | 9 | 0.33 | 0.61 | 2.20 | 1.99 | 0.79 | 1.01 | 2.17 | 0.58 | | 0.70 |
| *U. arctos* | 10 | 4.32 | 1.46 | 6.96 | 0.54 | 4.98 | 4.75 | 7.51 | 3.95 | 2.40 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 1.90 | 3.04 | 2.81 | 0.07 | 0.24 | 2.07 | 0.94 | 1.40 | 2.01 |
| *U. k. praekudarensis* | 2 | 0.44 | | 0.58 | 3.44 | 1.63 | 1.51 | 0.81 | 1.33 | 2.61 | 2.96 |
| *U. k. kudarensis* | 3 | 2.60 | 1.74 | | 5.53 | 1.75 | 1.65 | 0.55 | 1.60 | 3.62 | 5.07 |
| *U. rossicus* | 4 | 3.54 | 1.63 | 5.48 | | 1.84 | 2.32 | 4.51 | 3.42 | 0.99 | 0.95 |
| *U. s. spelaeus* | 5 | 0.68 | 0.78 | 1.69 | 3.84 | | 0.24 | 1.35 | 0.68 | 0.95 | 1.22 |
| *U. k. kanivetz* | 6 | 0.28 | 0.56 | 1.47 | 2.85 | 0.20 | | 1.20 | 0.45 | 1.31 | 1.67 |
| *U. k. ingressus* | 7 | 3.93 | 2.41 | 1.26 | 6.54 | 2.89 | 2.35 | | 0.96 | 2.94 | 3.91 |
| *U. s. eremus* | 8 | 0.23 | 0.54 | 1.92 | 3.26 | 0.36 | 0.09 | 3.01 | | 2.05 | 2.73 |
| *U. s. ladinicus* | 9 | 0.56 | 0.01 | 2.17 | 1.94 | 0.98 | 0.67 | 3.00 | 0.67 | | 0.20 |
| *U. arctos* | 10 | 3.55 | 1.59 | 5.54 | 0.09 | 3.85 | 2.81 | 6.63 | 3.25 | 1.90 | |

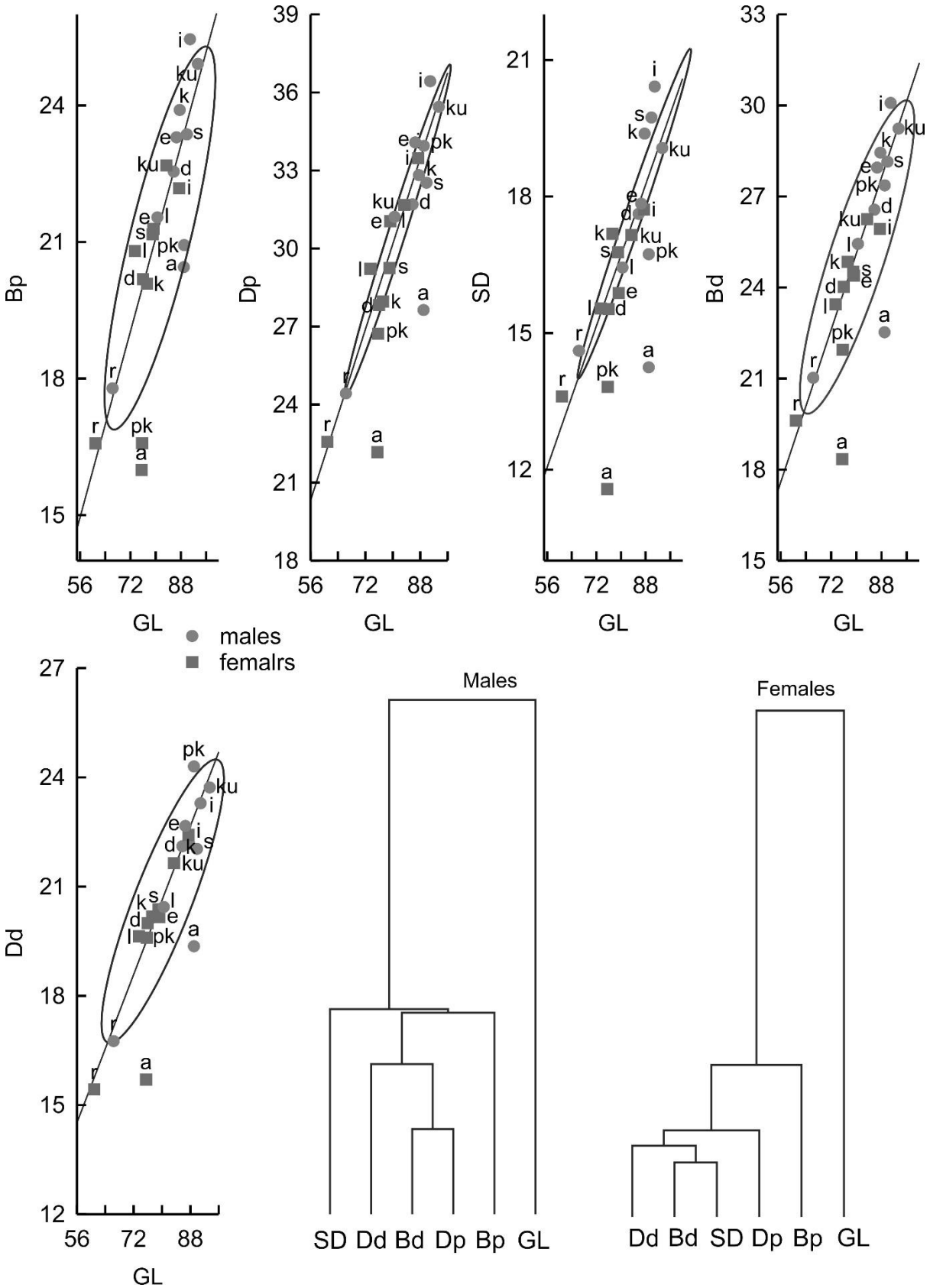


Fig. S16. The scatterplots of length of mtc IV and the other measures (BP – DD) and Relationships between measures of mtc IV (single linkage, correlation distances used): et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. The dashed lines are lines of regressions and ellipses' horizontal and vertical projections onto the axes are equal to the "sample mean ± "sample range" x 0.95

Table S25. Statistical parameters of measures of mtc IV among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | Std.Dev. | BP - N | BP | Std.Dev. | Dp- N | Dp | Std.Dev. | SD - N | SD | Std.Dev. | Bd - N | Bd | Std.Dev. | Dd- N | Dd | Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. rossicus* | f | 15 | 60.9 | 1.99 | 12 | 16.6 | 0.86 | 12 | 22.6 | 0.83 | 12 | 13.6 | 0.85 | 15 | 19.6 | 1.09 | 10 | 15.4 | 0.94 |
| | m | 11 | 66.4 | 2.71 | 8 | 17.8 | 0.67 | 7 | 24.4 | 0.73 | 8 | 14.6 | 1.10 | 11 | 21.0 | 0.72 | 7 | 16.8 | 0.81 |
| *U. deningeri* | f | 24 | 76.0 | 2.65 | 24 | 20.2 | 1.61 | 24 | 27.8 | 2.45 | 24 | 15.5 | 0.94 | 23 | 24.0 | 1.89 | 23 | 20.0 | 0.97 |
| | m | 13 | 85.8 | 4.00 | 13 | 22.5 | 1.77 | 13 | 31.7 | 1.55 | 13 | 17.6 | 0.85 | 13 | 26.6 | 1.31 | 13 | 22.1 | 0.89 |
| *U. k. praekudar.* | f | 3 | 75.7 | 1.21 | 5 | 16.6 | 1.41 | 4 | 26.7 | 1.19 | 5 | 13.8 | 1.58 | 4 | 22.0 | 2.31 | 3 | 19.6 | 1.82 |
| | m | 3 | 89.0 | 6.64 | 3 | 20.9 | 0.60 | 2 | 34.0 | 0.92 | 3 | 16.7 | 1.10 | 3 | 27.4 | 1.08 | 2 | 24.3 | 0.99 |
| *U. k. kudarensis* | f | 17 | 83.4 | 5.59 | 20 | 22.7 | 2.45 | 18 | 31.7 | 3.27 | 20 | 17.2 | 1.99 | 19 | 26.3 | 2.76 | 18 | 21.6 | 1.95 |
| | m | 31 | 93.4 | 4.29 | 33 | 24.9 | 1.82 | 33 | 35.4 | 2.49 | 34 | 19.1 | 1.43 | 32 | 29.2 | 2.29 | 28 | 23.7 | 1.35 |
| *U. s. spelaeus* | f | 22 | 79.0 | 2.43 | 21 | 21.2 | 1.01 | 18 | 29.3 | 1.83 | 22 | 16.8 | 0.83 | 22 | 24.5 | 1.30 | 15 | 20.4 | 1.03 |
| | m | 6 | 89.9 | 3.03 | 6 | 23.4 | 1.92 | 6 | 32.5 | 1.73 | 6 | 19.7 | 1.59 | 6 | 28.2 | 2.15 | 3 | 22.0 | 1.10 |
| *U. k. kanivetz* | f | 13 | 77.2 | 3.04 | 13 | 20.1 | 0.77 | 12 | 28.0 | 2.08 | 13 | 17.2 | 0.82 | 13 | 24.8 | 1.37 | 6 | 20.2 | 0.64 |
| | m | 5 | 87.6 | 1.61 | 5 | 23.9 | 1.08 | 5 | 32.8 | 1.33 | 5 | 19.4 | 0.59 | 5 | 28.4 | 1.36 | 4 | 22.2 | 1.40 |
| *U. s. eremus* | f | 11 | 79.3 | 2.62 | 11 | 21.3 | 1.01 | 11 | 31.0 | 1.47 | 11 | 15.9 | 1.02 | 11 | 24.4 | 1.16 | 11 | 20.2 | 1.06 |
| | m | 9 | 86.6 | 2.67 | 9 | 23.3 | 1.13 | 9 | 34.1 | 0.95 | 9 | 17.8 | 0.95 | 9 | 28.0 | 1.15 | 9 | 22.7 | 1.09 |
| *U. s. ladinicus* | f | 5 | 73.5 | 2.18 | 5 | 20.8 | 1.55 | 5 | 29.2 | 0.47 | 5 | 15.5 | 1.17 | 5 | 23.4 | 1.84 | 5 | 19.6 | 1.32 |
| | m | 5 | 80.5 | 2.74 | 5 | 21.5 | 0.86 | 5 | 31.2 | 2.25 | 5 | 16.4 | 0.78 | 5 | 25.4 | 0.87 | 5 | 20.4 | 0.91 |
| *U. k. ingressus* | f | 31 | 87.4 | 4.82 | 5 | 22.2 | 1.88 | 3 | 33.5 | 1.01 | 33 | 17.7 | 1.02 | 31 | 25.9 | 1.54 | 18 | 22.4 | 1.09 |
| | m | 14 | 90.9 | 3.79 | 9 | 25.5 | 1.37 | 8 | 36.4 | 2.44 | 14 | 20.4 | 1.00 | 14 | 30.1 | 1.58 | 12 | 23.3 | 0.90 |
| *U. arctos* | f | 17 | 75.5 | 5.59 | 17 | 16.0 | 1.56 | 12 | 22.2 | 2.19 | 17 | 11.6 | 1.18 | 17 | 18.3 | 1.46 | 11 | 15.7 | 1.21 |
| | m | 10 | 89.0 | 9.48 | 10 | 20.5 | 2.81 | 9 | 27.6 | 2.47 | 10 | 14.3 | 1.93 | 10 | 22.5 | 2.52 | 10 | 19.4 | 1.75 |

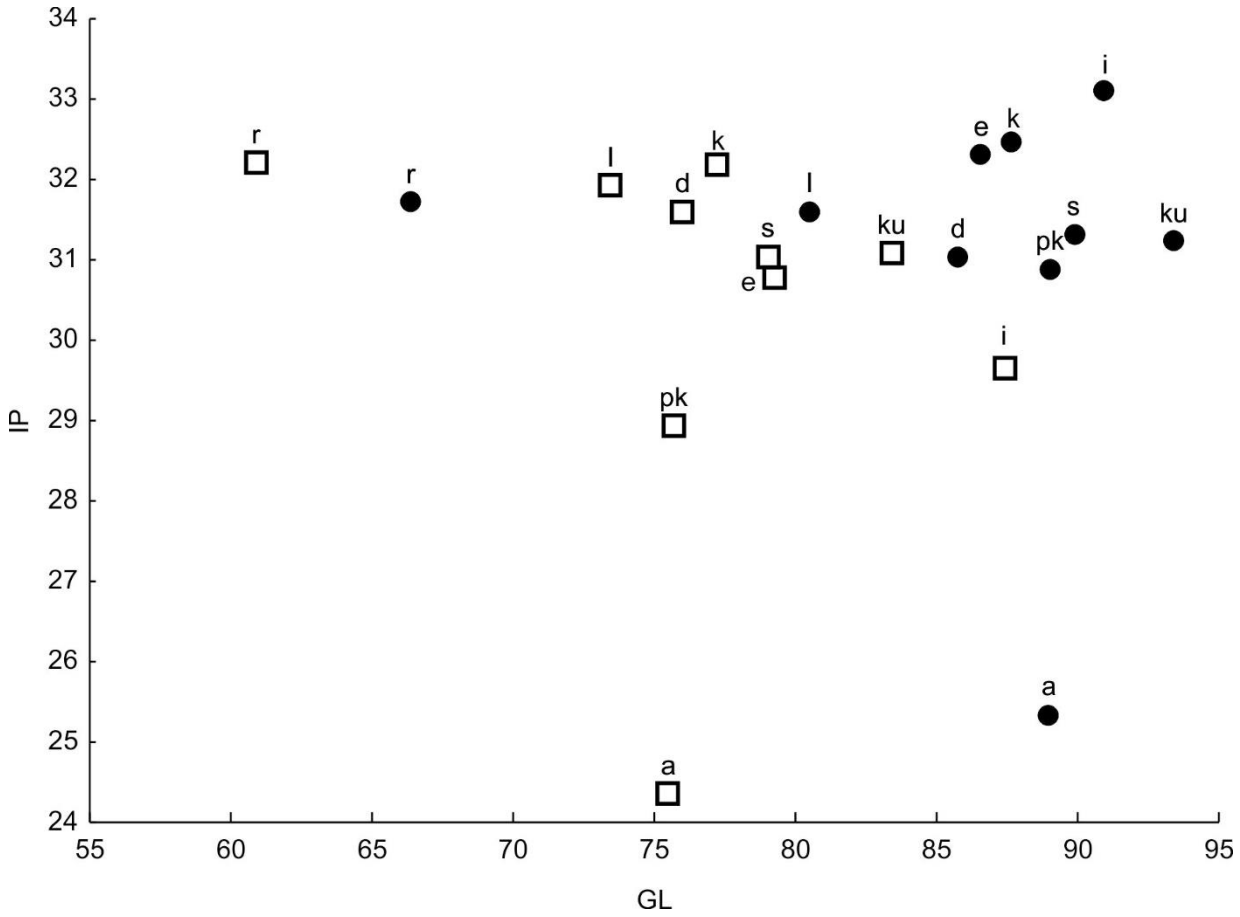


Fig. S17. The scatterplot of Index plumpness (ip) and GL of mtc IV: a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Points – males, squares – females.

## Multivariate analysis

Table 26. Description of the modeled morphological spaces for cave bears and brown bear mtc IV. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.88 | 0.44 | -0.36 | -0.17 | 0.97 | 0.94 | -0.21 | 0.12 | -0.40 | 0.96 |
| Bp | 0.96 | -0.03 | 0.14 | -0.06 | 0.93 | 0.95 | 0.01 | -0.08 | -0.02 | 0.93 |
| Dp | 0.95 | 0.06 | 0.02 | 0.07 | 0.94 | 0.94 | -0.21 | 0.14 | -0.10 | 0.93 |
| SD | 0.93 | -0.27 | 0.26 | -0.24 | 0.96 | 0.93 | 0.31 | -0.35 | -0.22 | 0.98 |
| Bd | 0.97 | -0.13 | 0.17 | -0.24 | 0.96 | 0.96 | 0.07 | -0.12 | -0.20 | 0.93 |
| Dd | 0.96 | 0.08 | -0.05 | -0.07 | 0.94 | 0.95 | -0.15 | 0.07 | -0.19 | 0.92 |
| ip | 0.18 | -0.68 | 0.69 | -0.18 | 0.84 | 0.19 | 0.54 | -0.47 | 0.34 | 0.46 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 67.1 | 60.9 | 47.9 | 9.6 | | 65.0 | 32.1 | 24.4 | 12.6 | |

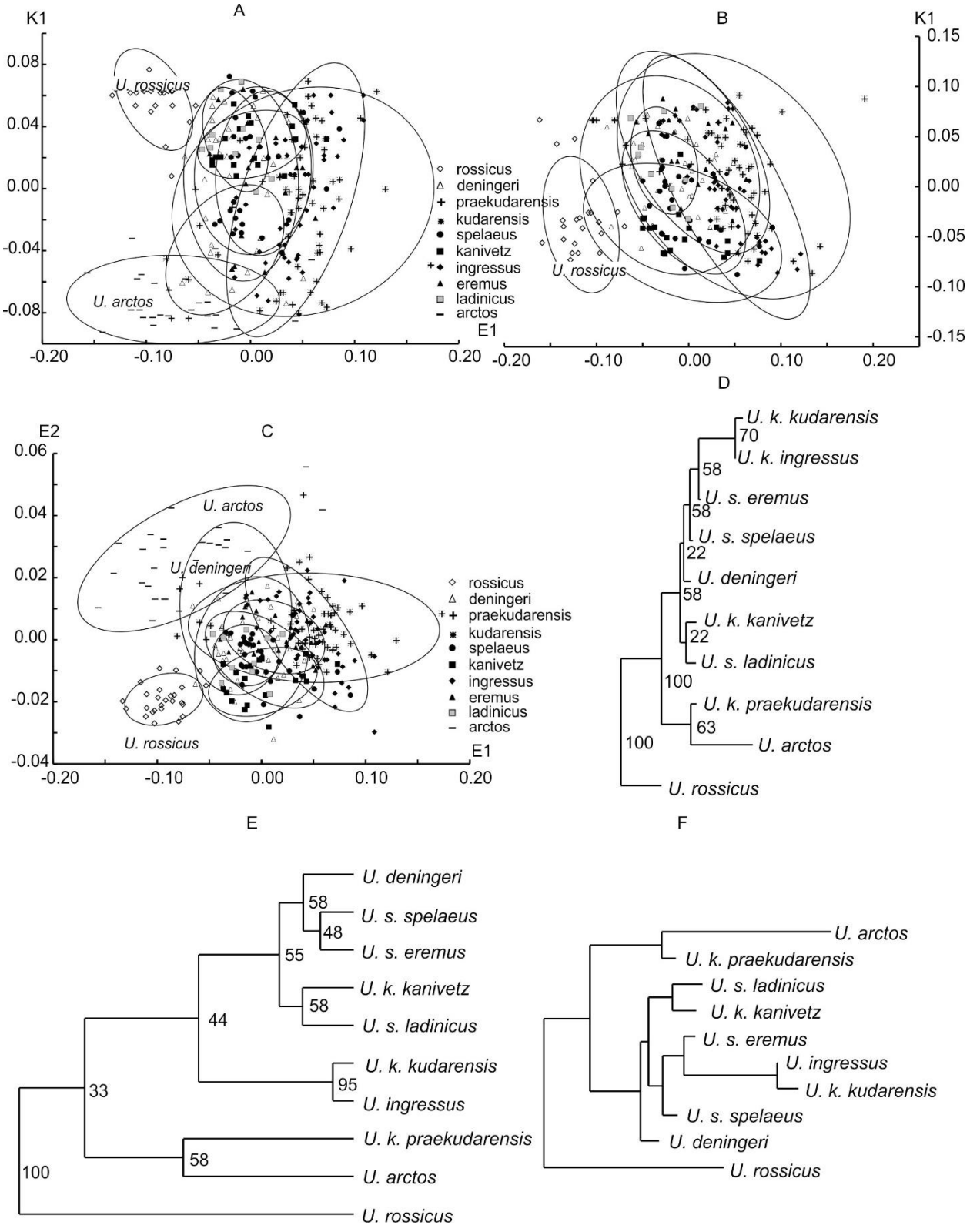


Fig. S18. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc IV in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.86); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S27. Description of the modeled morphological spaces for males of cave bears and brown bear mtc IV. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | |
|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | K1 | |
| GL | 0.83 | 0.40 | -0.35 | -0.05 | 0.94 | 0.91 | 0.31 | 0.89 |
| Bp | 0.93 | -0.14 | 0.23 | 0.15 | 0.94 | 0.92 | -0.13 | 0.89 |
| Dp | 0.95 | -0.09 | 0.04 | -0.04 | 0.90 | 0.94 | 0.13 | 0.87 |
| SD | 0.90 | -0.47 | 0.33 | -0.12 | 0.92 | 0.89 | -0.25 | 0.87 |
| Bd | 0.96 | -0.24 | 0.22 | -0.21 | 0.97 | 0.96 | 0.05 | 0.93 |
| Dd | 0.95 | 0.04 | -0.07 | -0.05 | 0.92 | 0.92 | 0.28 | 0.89 |
| ip | 0.23 | -0.60 | 0.62 | -0.17 | 0.81 | 0.25 | -0.40 | 0.24 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | |
| | 80.6 | 65.3 | 42.4 | 0.0 | | 83.9 | 34.3 | |

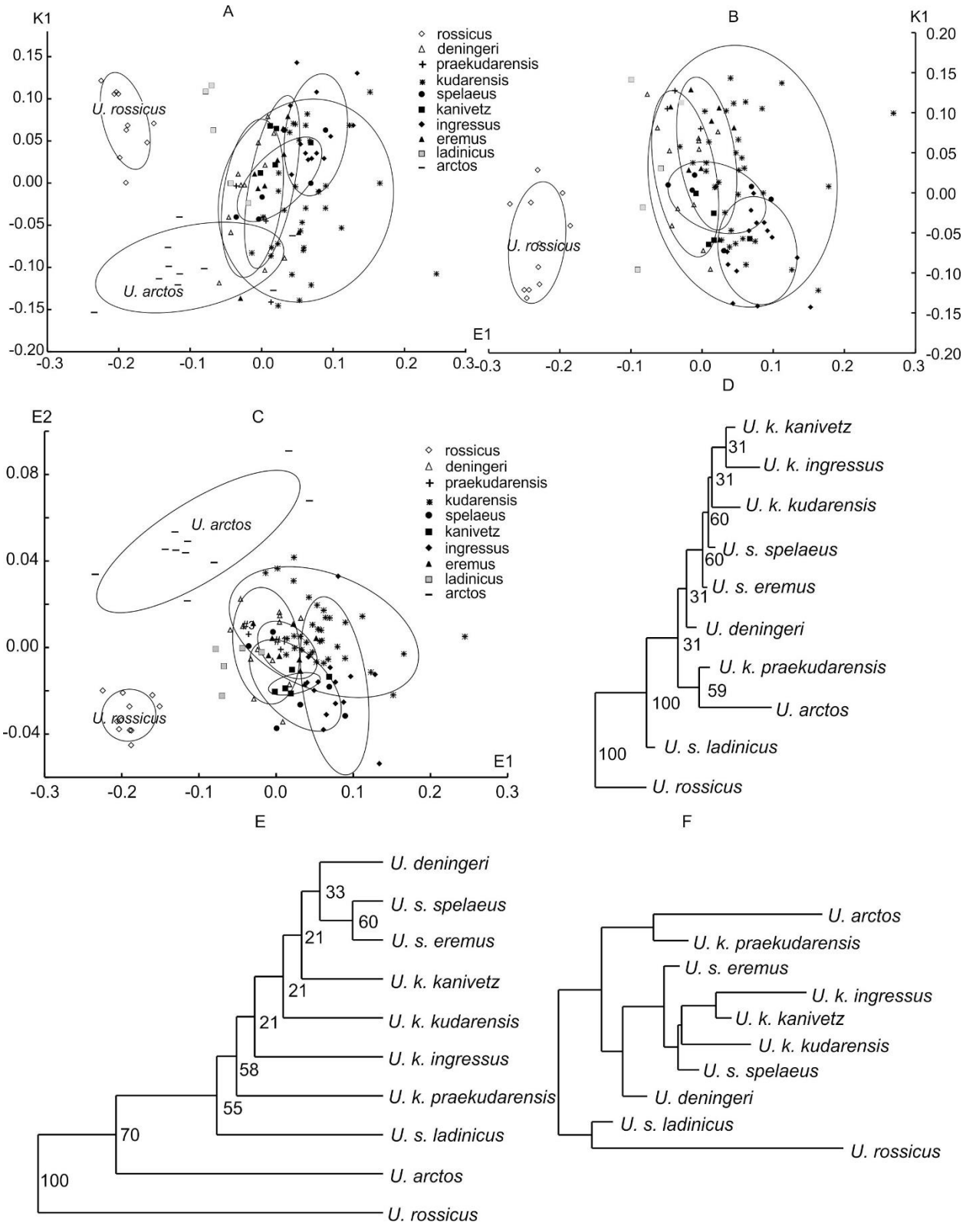


Fig. S19. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc IV in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.93); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S28. Description of the modeled morphological spaces for females of cave bears and brown bear mtc IV. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.77 | 0.40 | -0.20 | -0.10 | 0.89 | 0.92 | -0.17 | 0.07 | 0.04 | 0.93 |
| Bp | 0.95 | -0.18 | 0.26 | -0.43 | 0.90 | 0.93 | 0.04 | -0.13 | 0.19 | 0.85 |
| Dp | 0.95 | -0.05 | 0.07 | -0.33 | 0.91 | 0.93 | -0.19 | 0.07 | 0.42 | 0.97 |
| SD | 0.93 | -0.44 | 0.48 | -0.35 | 0.95 | 0.91 | 0.37 | -0.47 | 0.29 | 0.96 |
| Bd | 0.96 | -0.33 | 0.37 | -0.27 | 0.96 | 0.94 | 0.22 | -0.29 | 0.28 | 0.91 |
| Dd | 0.96 | -0.10 | 0.10 | -0.48 | 0.96 | 0.94 | -0.04 | -0.10 | 0.05 | 0.92 |
| ip | -0.05 | -0.67 | 0.61 | 0.18 | 0.77 | -0.04 | 0.57 | -0.56 | 0.45 | 0.57 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 81.2 | 66.6 | 48.1 | 28.9 | | 75.1 | 35.6 | 25.6 | 7.1 | |

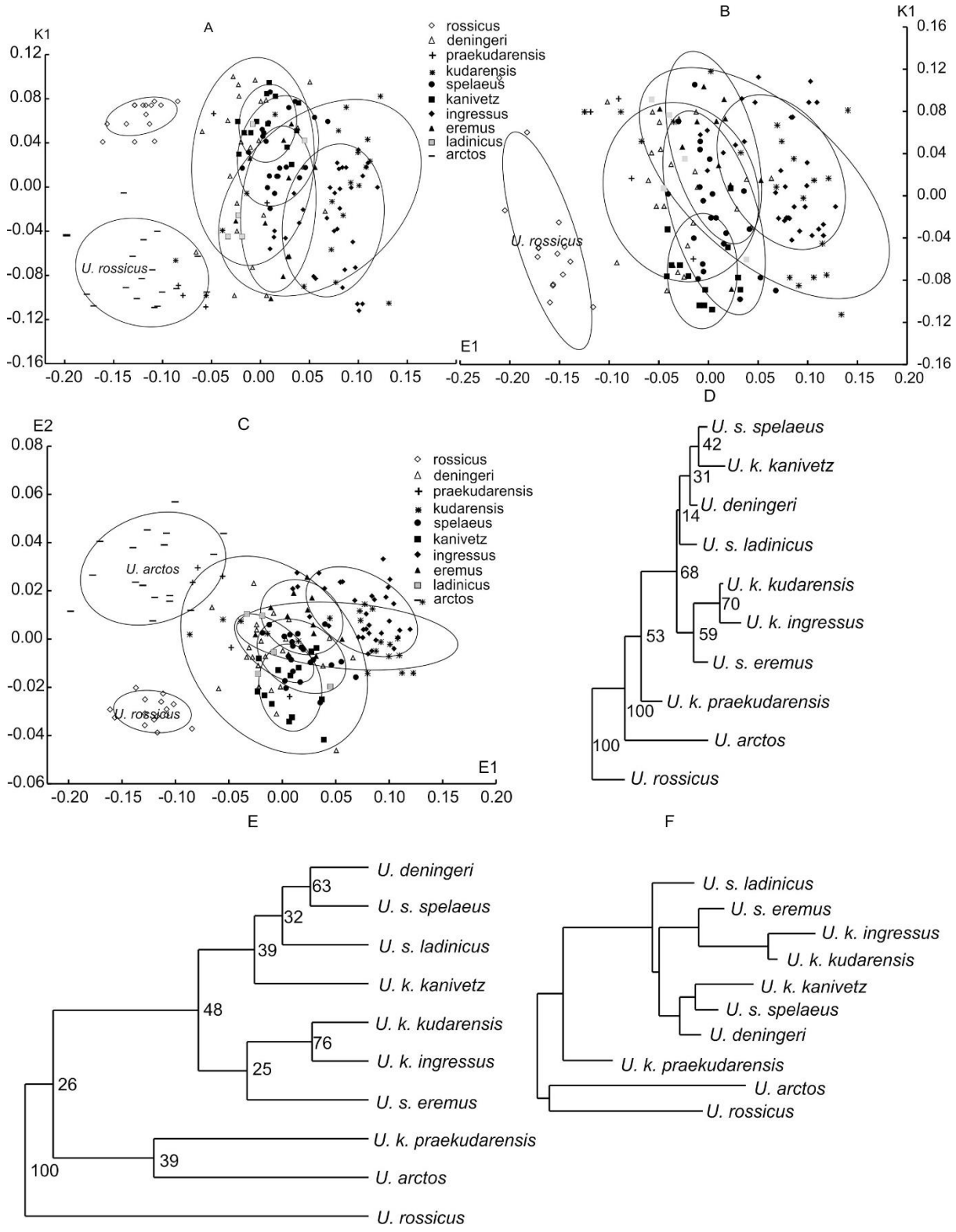


Fig. S20. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc IV in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.81); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METACARPAL BONE V (MTC V)

## Males and females

Table S29. Sample numbers (N), means (M), and standard errors (m) of the variables of mtc V among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus** | 3 | 79.3±2.89 | 1 | 19.5 | | no data | 3 | 13.8±0.59 |
| *U. deningeri* | 40 | 79.4±1.00 | 38 | 26.6±0.46 | 39 | 31.8±0.56 | 40 | 16.7±0.26 |
| *U. k. praekudarensis* | 4 | 86.7±4.32 | 6 | 29.7±1.66 | 8 | 36.3±1.62 | 9 | 17.5±0.87 |
| *U. k. kudarensis* | 63 | 89.9±0.70 | 71 | 32.0±0.32 | 74 | 36.8±0.41 | 74 | 19.2±0.24 |
| *U. rossicus* | 15 | 62.0±0.88 | 18 | 21.9±0.31 | 17 | 27.0±0.60 | 17 | 14.3±0.25 |
| *U. s. spelaeus* | 11 | 86.5±1.90 | 9 | 30.1±0.91 | 11 | 34.6±1.12 | 10 | 19.3±0.69 |
| *U. k. kanivetz* | 22 | 82.6±1.25 | 21 | 29.5±0.46 | 22 | 34.5±0.94 | 22 | 18.3±0.37 |
| *U. s. eremus* | 20 | 80.6±1.08 | 20 | 28.2±0.48 | 20 | 33.3±0.71 | 20 | 16.7±0.33 |
| *U. s. ladinicus* | 6 | 77.5±1.58 | 6 | 27.1±0.54 | 6 | 32.7±1.10 | 6 | 16.4±0.25 |
| *U. k. ingressus* | 55 | 88.6±0.71 | 27 | 31.3±0.55 | 27 | 36.8±0.68 | 57 | 19.7±0.28 |
| *U. arctos* | 31 | 83.9±1.85 | 29 | 23.3±0.70 | 23 | 28.2±1.04 | 31 | 14.3±0.48 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus** | 3 | 20.6±1.20 | 3 | 16.5±0.65 |
| *U. deningeri* | 40 | 26.5±0.35 | 40 | 19.5±0.28 |
| *U. k. praekudarensis* | 5 | 28.7±1.46 | 5 | 21.5±0.97 |
| *U. k. kudarensis* | 63 | 30.2±0.36 | 59 | 22.8±0.19 |
| *U. rossicus* | 15 | 22.6±0.55 | 12 | 15.6±0.25 |
| *U. s. spelaeus* | 10 | 28.9±0.84 | 6 | 21.4±0.72 |
| *U. k. kanivetz* | 22 | 28.5±0.70 | 20 | 20.7±0.39 |
| *U. s. eremus* | 20 | 26.3±0.38 | 19 | 20.3±0.25 |
| *U. s. ladinicus* | 6 | 26.2±0.63 | 6 | 19.5±0.31 |
| *U. k. ingressus* | 54 | 30.1±0.37 | 38 | 22.8±0.25 |
| *U. arctos* | 31 | 22.4±0.56 | 23 | 18.4±0.54 |

* Males only

### Sexual size dimorphism

Table S30. Sexual size dimorphism (*SSD* and *ASSD*) of mtc V in the different forms of cave bears and brown bear; *p* based on Mann-Whitney U Test; v, % - relative variance associated with SSD.

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 84.1±1.11 | 28.9±0.47 | 34.5±0.49 | 17.9±0.29 | 28.1±0.38 | 20.7±0.35 | |
| Females | 75.0±0.86 | 24.6±0.35 | 29.3±0.56 | 15.6±0.23 | 24.9±0.33 | 18.5±0.26 | |
| *SSD* | 5.7±0.88 ($p$<0.001) | 8.0±1.10 ($p$ <0.001) | 8.2±1.17 ($p$ <0.001) | 6.9±1.11 ($p$ <0.001) | 6.0±0.95 ($p$ <0.001) | 5.6±1.11 ($p$ <0.001) | 6.7 |
| *v, %* | 70.8 | 74.8 | 69.7 | 64.8 | 64.9 | 53.9 | |
| | | | | *U. rossicus* | | | |
| Males | 63.9±1.13 | 22.8±0.48 | 28.9±1.05 | 14.8±0.5 | 23.6±0.87 | 16.1±0.30 | |
| Females | 59.7±0.77 | 21.3±0.26 | 25.7±0.33 | 13.9±0.07 | 21.4±0.32 | 15.3±0.33 | |
| *SSD* | 3.4±1.11 | 3.4±1.24 | 5.9±2.02 | n.s. | 4.9±2.06 | n.s.. | 3.9 |

| | *SSD* | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | (*p*=0.01) | (*p*=0.03) | (*p*=0.003) | | (*p*=0.01) | | |
| *v, %* | 40.2 | 26.1 | 56.7 | - | 56.5 | - | |
| | | | *U. k. praekudarensis* | | | | |
| Males | 90.3±3.35 | 32.1±0.9 | 38.6±0.75 | 18.5±0.7 | 29.7±1.39 | 22.1±0.96 | |
| Females | 75.8* | 24.8±0.25 | 29.4±1.05 | 13.9±0.75 | 24.8* | 19.0* | |
| *SSD* | 8.7 | 12.8±1.7 (*p*=0.056) | 13.5±1.91 (*p*=0.056) | 14.2±3.2 (*p*=0.056) | 9.0 | 7.5 | 10.9 |
| *v, %** | - | - | - | - | - | - | |
| | | | *U. k. kudarensis* | | | | |
| Males | 91.4±0.44 | 32.8±0.24 | 38.1±0.31 | 19.9±0.22 | 31.2±0.28 | 23.3±0.15 | |
| Females | 81.2±1.34 | 29.4±1.93 | 32.6±0.84 | 17.1±0.5 | 26.3±0.65 | 20.9±0.41 | |
| *SSD* | 5.9±0.82 (*p*<0.001) | 5.5±1.55 (*p*<0.001) | 7.8±1.27 (*p*<0.001) | 7.6±1.48 (*p*<0.001) | 8.5±1.24 (*p*<0.001) | 5.4±0.99 (*p*<0.001) | 6.8 |
| *v, %* | 80.6 | 51.0 | 62.1 | 50.7 | 67.9 | 66.5 | |
| | | | *U. s. spelaeus* | | | | |
| Males | 91.6±0.67 | 31.8±0.92 | 37.2±1.14 | 21.2±0.35 | 30.8±0.44 | 23.4±0.45 | |
| Females | 80.4±1.46 | 28.1±0.96 | 31.5±0.71 | 17.3±0.40 | 26.2±0.84 | 20.4±0.54 | |
| *SSD* | 6.5±0.93 (*p*=0.008) | 6.2±2.22 (*p*=0.04) | 8.3±1.96 (*p*=0.01) | 10.1±1.39 (*p*=0.01) | 8.1±1.67 (*p*=0.01) | n.s. | 7.7 |
| *v, %* | 83.9 | 78.9 | 89.7 | 92.6 | 88.3 | - | |
| | | | *U. s. ladinicus* | | | | |
| Males | 80.5±1.63 | 27.7±0.58 | 34.8±0.73 | 16.6±0.24 | 27.1±0.32 | 19.7±0.55 | |
| Females | 74.6±1.16 | 26.5±0.87 | 30.6±1.03 | 16.1±0.43 | 25.3±1.02 | 19.4±0.37 | |
| *SSD* | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | 3.0 |
| *v, %** | - | - | - | - | - | - | |
| | | | *U. s. eremus* | | | | |
| Males | 87.2±1.60 | 31.0±0.69 | 37.4±0.64 | 18.6±0.25 | 28.8±0.33 | 23.9±2.10 | |
| Females | 78.4±0.69 | 27.2±0.33 | 31.9±0.59 | 16.1±0.27 | 25.5±0.21 | 19.9±0.21 | |
| *SSD* | 5.3±1.05 (*p*=0.002) | 6.6±1.32 (*p*=0.001) | 7.8±1.25 (*p*=0.001) | 7.2±1.07 (*p*=0.002) | 6.2±0.73 (*p*=0.001) | 9.1±4.84 (*p*=0.008) | 7.0 |
| *v, %* | 79.5 | 79.8 | 72.9 | 76.3 | 89.3 | 73.9 | |
| | | | *U. k. ingressus* | | | | |
| Males | 91.9±0.58 | 33.4±0.30 | 39.4±0.47 | 21±0.22 | 31.7±0.25 | 23.5±0.13 | |
| Females | 83.0±0.33 | 28.4±0.47 | 33.1±0.37 | 17.4±0.24 | 27.0±0.35 | 20.5±0.37 | |
| *SSD* | 5.1±0.45 (*p*<0.001) | 8.1±0.91 (*p*<0.001) | 8.7±0.83 (*p*<0.001) | 9.4±0.85 (*p*<0.001) | 8.0±0.74 (*p*<0.001) | 6.8±0.89 (*p*<0.001) | 7.7 |
| *v, %* | 86.2 | 85.9 | 87.3 | 84.7 | 84.0 | 88.8 | |
| | | | *U. kanivetz* | | | | |
| Males | 88.7±1.1 | 32.5±0.44 | 39.2±0.98 | 20.2±0.27 | 31.8±0.59 | 22.6±0.41 | |
| Females | 79.2±1.03 | 27.7±0.55 | 31.9±0.69 | 17.3±0.31 | 26.6±0.60 | 19.7±0.27 | |
| *SSD* | 5.7±0.90 (*p*<0.001) | 8.0±1.17 (*p*<0.001) | 10.3±1.69 (*p*<0.001) | 7.8±1.11 (*p*<0.001) | 9.0±1.44 (*p*<0.001) | 6.9±1.16 (*p*<0.001) | 7.9 |
| *v, %* | 77.5 | 79.2 | 79.2 | 79.8 | 77.8 | 80.2 | |
| | | | *U. arctos* | | | | |
| Males | 91.1±2.0 | 26.4±0.69 | 31.3±0.95 | 15.9±0.38 | 24.7±0.60 | 19.8±0.46 | |
| Females | 76.2±1.52 | 20.5±0.53 | 23.3±0.71 | 12.1±0.27 | 19.9±0.41 | 16.3±0.78 | |
| *SSD* | 8.9±1.51 (*p*<0.001) | 12.6±1.87 (*p*<0.001) | 14.7±2.20 (*p*<0.001) | 13.4±1.67 (*p*<0.001) | 10.6±1.63 (*p*<0.001) | 9.7±2.52 (*p*=0.002) | 11.6 |
| *v, %* | 66.2 | 78.8 | 81.2 | 75.4 | 75.7 | 59.9 | |

**Univariate analysis**

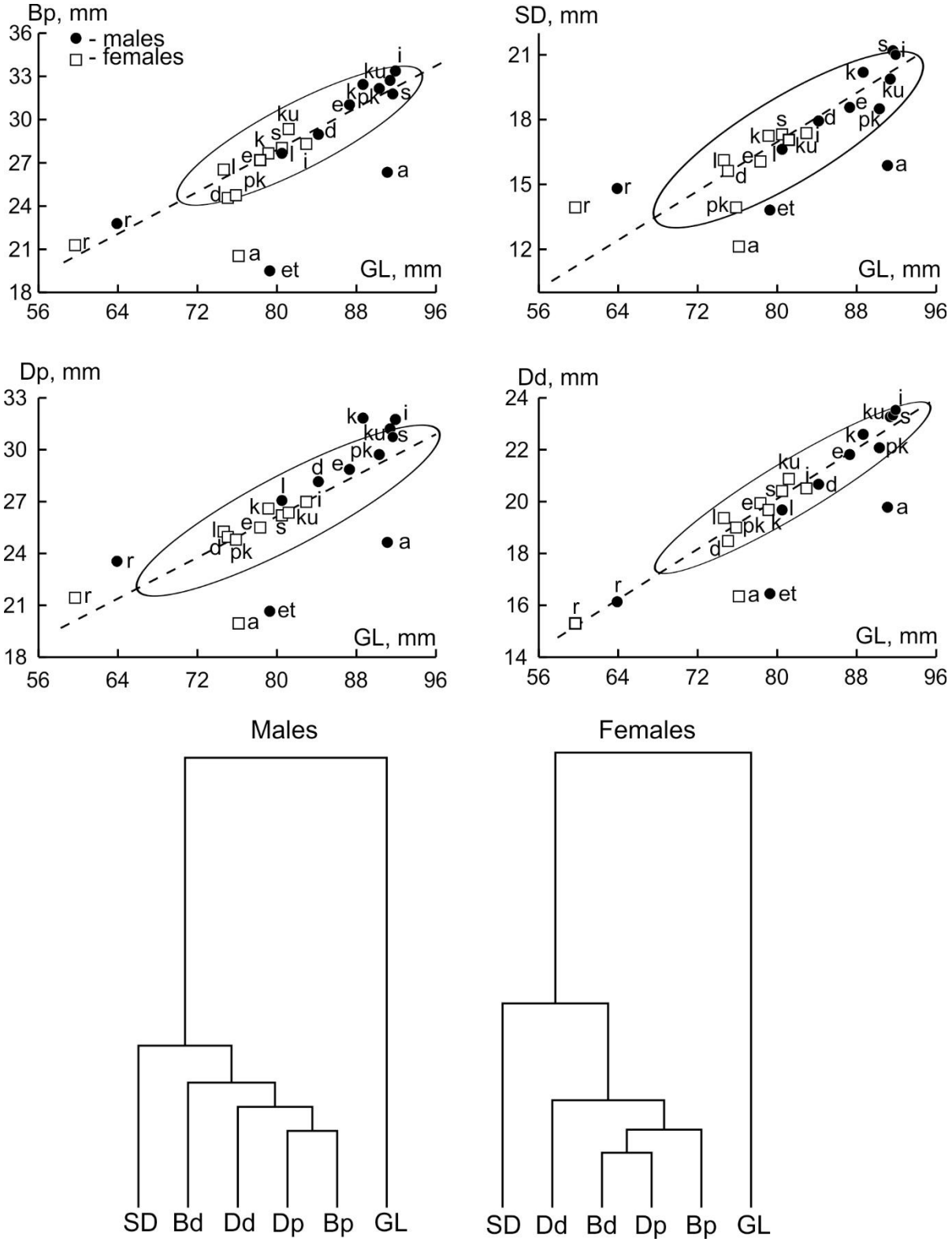


Fig. S21. The scatterplots of measures (GL – Dd) of mtc V and their classification: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*.

Table S31. Statistical parameters of measures of mtc V among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | Std.Dev. | BP - N | BP | Std.Dev. | Dp- N | Dp | Std.Dev. | SD - N | SD | Std.Dev. | Bd - N | Bd | Std.Dev. | Dd- N | Dd | Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | m | 3 | 79.3 | 5.01 | 1 | 19.5 | | | | | 3 | 13.8 | 1.01 | 3 | 20.6 | 2.07 | 3 | 16.5 | 1.12 |
| *U. rossicus* | m | 8 | 63.9 | 3.21 | 8 | 22.8 | 1.37 | 7 | 28.9 | 2.79 | 8 | 14.8 | 1.43 | 8 | 22.9 | 0.91 | 5 | 16.1 | 0.66 |
| | f | 7 | 59.7 | 2.04 | 10 | 21.3 | 0.81 | 10 | 25.7 | 1.03 | 9 | 13.9 | 0.21 | 7 | 21.4 | 0.86 | 7 | 15.3 | 0.88 |
| *U. deningeri* | m | 19 | 84.1 | 4.85 | 18 | 28.9 | 1.99 | 19 | 34.5 | 2.14 | 19 | 17.9 | 1.25 | 19 | 28.1 | 1.64 | 19 | 20.7 | 1.55 |
| | f | 21 | 75 | 3.93 | 20 | 24.6 | 1.56 | 20 | 29.3 | 2.52 | 21 | 15.6 | 1.05 | 21 | 24.9 | 1.5 | 21 | 18.5 | 1.18 |
| *U. k. praekudar.* | m | 3 | 90.3 | 5.81 | 4 | 32.1 | 1.8 | 6 | 38.6 | 1.83 | 7 | 18.5 | 1.86 | 4 | 29.7 | 2.78 | 4 | 22.1 | 1.93 |
| | f | 1 | 75.8 | | 2 | 24.8 | 0.35 | 2 | 29.4 | 1.48 | 2 | 13.9 | 1.06 | 1 | 24.8 | | 1 | 19 | |
| *U. k. kudarensis* | m | 49 | 91.4 | 3.05 | 56 | 32.8 | 1.81 | 57 | 38.1 | 2.33 | 57 | 19.9 | 1.64 | 50 | 31.2 | 1.96 | 47 | 23.3 | 1.06 |
| | f | 14 | 81.2 | 5.02 | 15 | 29.4 | 3.61 | 17 | 32.6 | 3.47 | 17 | 17.1 | 2.04 | 13 | 26.3 | 2.35 | 12 | 20.9 | 1.43 |
| *U. s. spelaeus* | m | 6 | 91.6 | 1.63 | 5 | 31.8 | 2.07 | 6 | 37.2 | 2.79 | 5 | 21.2 | 0.78 | 6 | 30.8 | 1.09 | 2 | 23.4 | 0.64 |
| | f | 5 | 80.4 | 3.25 | 4 | 28.1 | 1.93 | 5 | 31.5 | 1.59 | 5 | 17.3 | 0.89 | 4 | 26.2 | 1.69 | 4 | 20.4 | 1.07 |
| *U. k. kanivetz* | m | 8 | 88.7 | 3.11 | 8 | 32.5 | 1.25 | 8 | 39.2 | 2.77 | 8 | 20.2 | 0.77 | 8 | 31.8 | 1.67 | 7 | 22.6 | 1.09 |
| | f | 14 | 79.2 | 3.86 | 13 | 27.7 | 1.97 | 14 | 31.9 | 2.57 | 14 | 17.3 | 1.16 | 14 | 26.6 | 2.24 | 13 | 19.7 | 0.98 |
| *U. s. eremus* | m | 5 | 87.2 | 3.57 | 5 | 31 | 1.54 | 5 | 37.4 | 1.42 | 5 | 18.6 | 0.55 | 5 | 28.8 | 0.74 | 4 | 21.8 | 0.43 |
| | f | 15 | 78.4 | 2.67 | 15 | 27.2 | 1.29 | 15 | 32 | 2.27 | 15 | 16.1 | 1.06 | 15 | 25.5 | 0.82 | 15 | 19.9 | 0.82 |
| *U. s. ladinicus* | m | 3 | 80.5 | 2.82 | 3 | 27.7 | 1.0 | 3 | 34.8 | 1.27 | 3 | 16.6 | 0.42 | 3 | 27.1 | 0.56 | 3 | 19.7 | 0.95 |
| | f | 3 | 74.6 | 2 | 3 | 26.5 | 1.51 | 3 | 30.6 | 1.78 | 3 | 16.1 | 0.75 | 3 | 25.3 | 1.77 | 3 | 19.4 | 0.64 |
| *U. k. kanivetz* | m | 35 | 91.9 | 3.43 | 16 | 33.4 | 1.22 | 16 | 39.4 | 1.87 | 36 | 21 | 1.29 | 35 | 31.7 | 1.49 | 29 | 23.5 | 0.69 |
| | f | 20 | 83 | 2.36 | 11 | 28.4 | 1.55 | 11 | 33.1 | 1.24 | 21 | 17.4 | 1.1 | 19 | 27 | 1.52 | 9 | 20.5 | 1.12 |
| *U. arctos* | m | 16 | 91.1 | 8 | 14 | 26.4 | 2.58 | 14 | 31.3 | 3.56 | 16 | 15.9 | 1.51 | 16 | 24.7 | 2.4 | 14 | 19.8 | 1.71 |
| | f | 15 | 76.2 | 5.89 | 15 | 20.5 | 2.06 | 9 | 23.3 | 2.12 | 15 | 12.1 | 1.04 | 15 | 19.9 | 1.58 | 9 | 16.3 | 2.34 |

Table S32. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for GL and BP of mtc V between bear taxa. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 1.75 | 1.90 | 4.65 | 3.01 | 4.79 | 1.44 | 0.73 | 0.74 | 2.93 |
| *U. rossicus* | 2 | 2.35 | | 2.84 | 5.23 | 3.97 | 5.36 | 2.69 | 1.94 | 0.41 | 4.00 |
| *U. k. praekudarensis* | 3 | 0.05 | 1.01 | | 0.12 | 0.32 | 0.30 | 0.85 | 1.12 | 2.01 | 0.30 |
| *U. k. kudarensis* | 4 | 3.32 | 4.69 | 1.05 | | 0.35 | 0.49 | 1.70 | 1.89 | 2.89 | 0.91 |
| *U. s. spelaeus* | 5 | 2.20 | 3.62 | 0.95 | 0.10 | | 0.10 | 1.48 | 1.72 | 2.64 | 0.86 |
| *U. k. ingressus* | 6 | 5.00 | 5.90 | 1.47 | 1.20 | 0.94 | | 1.94 | 2.09 | 3.03 | 1.23 |
| *U. k. kanivetz* | 7 | 2.26 | 3.90 | 0.70 | 0.97 | 0.61 | 2.25 | | 0.42 | 1.58 | 0.90 |
| *U. s. eremus* | 8 | 1.78 | 3.56 | 0.53 | 1.46 | 0.95 | 2.82 | 0.48 | | 1.13 | 1.22 |
| *U. s. ladinicus* | 9 | 0.41 | 1.12 | 0.26 | 2.19 | 1.84 | 2.93 | 1.62 | 1.35 | | 2.31 |
| *U. arctos* | 10 | 0.68 | 2.74 | 0.17 | 2.47 | 1.68 | 3.91 | 1.48 | 1.02 | 0.76 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 1.93 | 2.13 | 4.69 | 1.67 | 4.67 | 2.92 | 1.20 | 0.59 | 1.30 |
| *U. rossicus* | 2 | 1.99 | | 3.26 | 5.53 | 2.92 | 5.60 | 4.12 | 2.50 | 0.67 | 0.80 |
| *U. k. praekudarensis* | 3 | 0.05 | 0.95 | | 0.18 | 0.49 | 0.77 | 0.10 | 0.85 | 2.02 | 2.89 |
| *U. k. kudarensis* | 4 | 3.81 | 5.08 | 1.78 | | 0.92 | 1.18 | 0.09 | 1.43 | 2.76 | 5.81 |
| *U. s. spelaeus* | 5 | 2.19 | 3.33 | 1.43 | 0.18 | | 1.49 | 0.69 | 0.38 | 1.66 | 2.51 |
| *U. k. ingressus* | 6 | 3.50 | 4.77 | 1.76 | 0.03 | 0.19 | | 0.85 | 1.95 | 3.13 | 5.65 |
| *U. k. kanivetz* | 7 | 2.98 | 4.36 | 1.45 | 0.63 | 0.24 | 0.61 | | 1.11 | 2.37 | 3.84 |
| *U. s. eremus* | 8 | 2.81 | 4.24 | 1.33 | 0.93 | 0.42 | 0.89 | 0.27 | | 1.33 | 2.05 |
| *U. s. ladinicus* | 9 | 1.05 | 2.16 | 0.75 | 1.03 | 0.72 | 1.02 | 0.64 | 0.49 | | 0.15 |
| *U. arctos* | 10 | 2.62 | 0.30 | 1.14 | 6.01 | 3.72 | 5.56 | 5.16 | 5.08 | 2.44 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 1.61 | 2.87 | 4.29 | 2.01 | 4.74 | 3.58 | 1.81 | 0.03 | 1.24 |
| *U. rossicus* | 2 | 2.22 | | 3.69 | 4.61 | 2.97 | 5.12 | 4.29 | 2.76 | 1.00 | 0.59 |
| *U. k. praekudarensis* | 3 | 0.00 | 1.10 | | 0.48 | 0.70 | 0.56 | 0.31 | 0.72 | 1.92 | 3.65 |
| *U. k. kudarensis* | 4 | 2.87 | 4.53 | 1.27 | | 0.46 | 1.67 | 0.99 | 0.49 | 1.95 | 5.28 |
| *U. s. spelaeus* | 5 | 1.39 | 2.84 | 0.83 | 0.49 | | 1.40 | 1.05 | 0.06 | 1.36 | 2.83 |
| *U. k. ingressus* | 6 | 3.41 | 4.89 | 1.67 | 0.86 | 1.08 | | 0.23 | 1.37 | 2.59 | 5.60 |
| *U. k. kanivetz* | 7 | 2.23 | 3.95 | 1.03 | 0.47 | 0.16 | 1.25 | | 1.06 | 2.26 | 4.39 |
| *U. s. eremus* | 8 | 2.60 | 4.27 | 1.18 | 0.17 | 0.37 | 0.99 | 0.30 | | 1.27 | 2.58 |
| *U. s. ladinicus* | 9 | 0.52 | 1.79 | 0.35 | 1.00 | 0.51 | 1.47 | 0.72 | 0.90 | | 0.66 |
| *U. arctos* | 10 | 2.75 | 0.54 | 1.41 | 4.97 | 3.23 | 5.30 | 4.40 | 4.72 | 2.14 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 1.94 | 0.77 | 3.58 | 3.40 | 5.43 | 2.67 | 0.37 | 0.79 | 1.78 |
| *U. rossicus* | 2 | 2.05 | | 2.24 | 4.69 | 4.43 | 6.04 | 3.89 | 1.76 | 0.48 | 0.50 |
| *U. k. praekudarensis* | 3 | 1.14 | 0.04 | | 1.52 | 2.34 | 2.91 | 1.52 | 0.26 | 1.21 | 2.08 |
| *U. k. kudarensis* | 4 | 2.40 | 3.88 | 2.18 | | 1.63 | 2.78 | 0.46 | 1.64 | 2.43 | 5.49 |
| *U. s. spelaeus* | 5 | 2.13 | 3.36 | 2.28 | 0.54 | | 0.35 | 1.03 | 2.41 | 3.01 | 4.51 |
| *U. k. ingressus* | 6 | 3.38 | 4.66 | 2.55 | 0.79 | 0.04 | | 1.06 | 2.84 | 3.38 | 7.13 |
| *U. k. kanivetz* | 7 | 2.79 | 4.16 | 2.39 | 0.50 | 0.18 | 0.23 | | 1.65 | 2.39 | 3.99 |
| *U. s. eremus* | 8 | 0.80 | 2.57 | 1.48 | 1.45 | 1.53 | 2.28 | 1.87 | | 0.93 | 1.54 |
| *U. s. ladinicus* | 9 | 0.50 | 1.68 | 1.26 | 0.76 | 1.03 | 1.19 | 1.03 | 0.06 | | 0.18 |
| *U. arctos* | 10 | 3.67 | 1.01 | 0.52 | 5.71 | 4.46 | 6.75 | 5.93 | 4.14 | 2.45 | |
| | | | | | Bd | | | | | | |
| *U. deningeri* | 1 | | 1.71 | 1.18 | 4.36 | 1.90 | 4.92 | 3.27 | 0.20 | 0.39 | 1.74 |
| *U. rossicus* | 2 | 2.63 | | 2.24 | 4.97 | 2.98 | 5.42 | 4.20 | 1.44 | 0.70 | 0.30 |
| *U. k. praekudarensis* | 3 | 0.30 | 0.78 | | 1.01 | 0.37 | 1.43 | 1.19 | 0.82 | 1.17 | 2.22 |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. k. kudarensis* | 4 | 1.35 | 3.46 | 0.76 | | 0.65 | 1.04 | 0.53 | 2.29 | 2.39 | 6.14 |
| *U. s. spelaeus* | 5 | 0.89 | 2.61 | 0.71 | 0.02 | | 1.16 | 0.90 | 1.31 | 1.61 | 3.09 |
| *U. k. ingressus* | 6 | 2.78 | 4.59 | 1.16 | 1.12 | 0.72 | | 0.07 | 2.73 | 2.74 | 6.61 |
| *U. k. kanivetz* | 7 | 1.86 | 3.86 | 0.92 | 0.43 | 0.27 | 0.68 | | 2.24 | 2.40 | 4.54 |
| *U. s. eremus* | 8 | 0.62 | 2.96 | 0.50 | 0.71 | 0.49 | 1.95 | 1.16 | | 0.47 | 1.35 |
| *U. s. ladinicus* | 9 | 0.07 | 1.73 | 0.31 | 0.67 | 0.58 | 1.35 | 0.94 | 0.26 | | 0.55 |
| *U. arctos* | 10 | 4.02 | 0.46 | 1.01 | 4.84 | 3.28 | 6.48 | 5.38 | 4.29 | 2.22 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 1.67 | 1.20 | 4.84 | 1.91 | 5.18 | 2.05 | 0.47 | 0.58 | 0.73 |
| *U. rossicus* | 2 | 2.18 | | 2.24 | 4.58 | 2.70 | 4.89 | 2.98 | 1.64 | 0.65 | 1.12 |
| *U. k. praekudarensis* | 3 | 0.12 | 1.01 | | 1.26 | 0.88 | 1.63 | 0.39 | 0.57 | 1.34 | 1.62 |
| *U. k. kudarensis* | 4 | 3.86 | 4.93 | 1.22 | | 0.15 | 0.91 | 1.01 | 2.03 | 2.82 | 5.16 |
| *U. s. spelaeus* | 5 | 2.39 | 3.60 | 1.05 | 0.16 | | 0.15 | 0.64 | 1.34 | 1.95 | 2.22 |
| *U. k. ingressus* | 6 | 3.21 | 4.42 | 1.09 | 0.27 | 0.04 | | 1.48 | 2.38 | 3.12 | 5.49 |
| *U. k. kanivetz* | 7 | 2.23 | 3.71 | 0.64 | 1.52 | 0.90 | 1.13 | | 1.03 | 1.84 | 2.51 |
| *U. s. eremus* | 8 | 2.82 | 4.16 | 0.80 | 1.14 | 0.62 | 0.77 | 0.44 | | 0.81 | 0.91 |
| *U. s. ladinicus* | 9 | 0.86 | 2.14 | 0.35 | 1.34 | 1.01 | 1.12 | 0.40 | 0.67 | | 0.17 |
| *U. arctos* | 10 | 1.42 | 0.77 | 0.65 | 4.45 | 3.11 | 3.91 | 3.12 | 3.60 | 1.64 | |

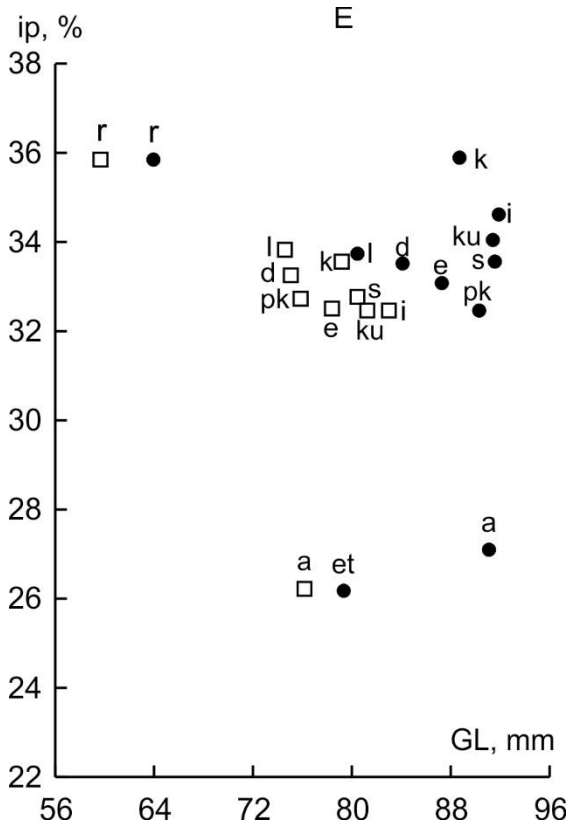


Fig. S22. Scatterplot of Index plumpness (ip) and GL of mtc V: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, k – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Points – males, squares – females.

## Multivariate analyses

Table S33. Description of the modeled morphological spaces for cave bears and brown bear mtc V. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.84 | 0.43 | -0.08 | -0.29 | 0.91 | 0.93 | 0.28 | 0.32 | 0.00 | 0.93 |
| Bp | 0.97 | 0.02 | 0.26 | -0.01 | 0.94 | 0.96 | 0.10 | 0.18 | 0.00 | 0.93 |
| Dp | 0.96 | -0.04 | 0.45 | -0.11 | 0.96 | 0.95 | 0.01 | 0.14 | 0.31 | 0.95 |
| SD | 0.94 | -0.20 | 0.38 | 0.25 | 0.96 | 0.93 | -0.22 | -0.16 | -0.00 | 0.95 |
| Bd | 0.96 | -0.19 | 0.44 | 0.02 | 0.96 | 0.95 | -0.17 | -0.03 | 0.18 | 0.95 |
| Dd | 0.96 | 0.13 | 0.19 | -0.12 | 0.94 | 0.97 | 0.12 | 0.19 | 0.00 | 0.95 |
| ip | 0.48 | -0.79 | 0.78 | 0.38 | 0.84 | 0.27 | -0.74 | -0.60 | 0.33 | 0.68 |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 60.7 | 56.0 | 47.8 | 25.9 | | 59.5 | 32.7 | 31.6 | 4.3 | |

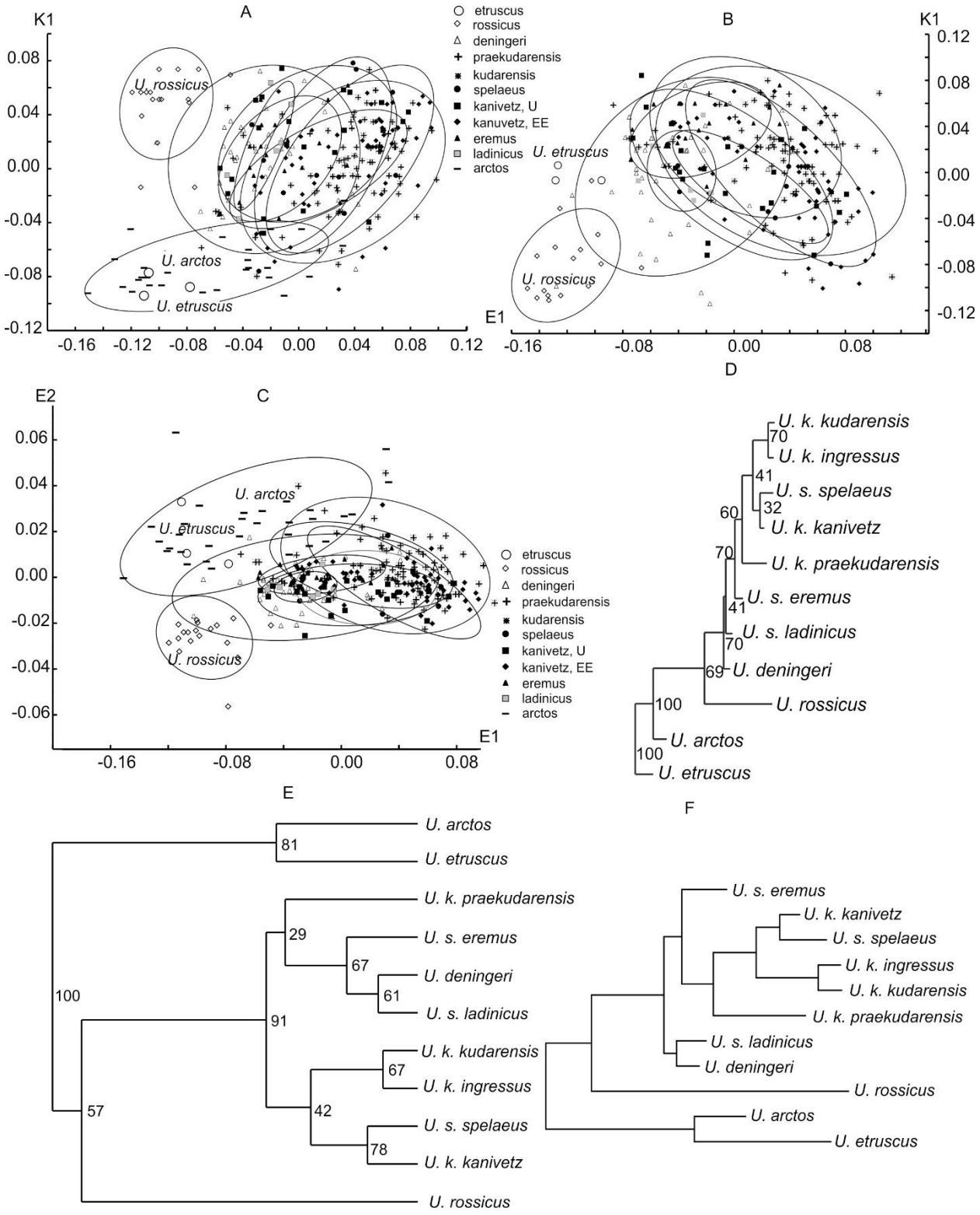


Fig. S23. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtc V in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.94); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" ± ("sample range" x 0.95).

## Males

Table S34. Description of the modeled morphological spaces for males of cave bears and brown bear mtc V. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | K1 | K2 | |
| GL | 0.72 | 0.61 | -0.33 | 0.09 | 0.87 | 0.92 | 0.39 | 0.43 | 0.86 |
| Bp | 0.96 | 0.07 | 0.25 | 0.15 | 0.92 | 0.95 | 0.12 | 0.35 | 0.91 |
| Dp | 0.93 | 0.04 | 0.33 | -0.07 | 0.92 | 0.90 | 0.15 | 0.10 | 0.87 |
| SD | 0.91 | -0.28 | 0.50 | 0.35 | 0.96 | 0.88 | -0.24 | 0.35 | 0.92 |
| Bd | 0.96 | -0.10 | 0.41 | 0.17 | 0.95 | 0.95 | -0.05 | 0.30 | 0.94 |
| Dd | 0.96 | 0.21 | 0.10 | 0.22 | 0.96 | 0.96 | 0.20 | 0.50 | 0.95 |
| ip | 0.39 | -0.59 | 0.71 | 0.07 | 0.81 | 0.36 | -0.55 | -0.21 | 0.58 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | |
| | 81.7 | 55.5 | 53.9 | 17.8 | | 84.8 | 21.3 | 28.7 | |

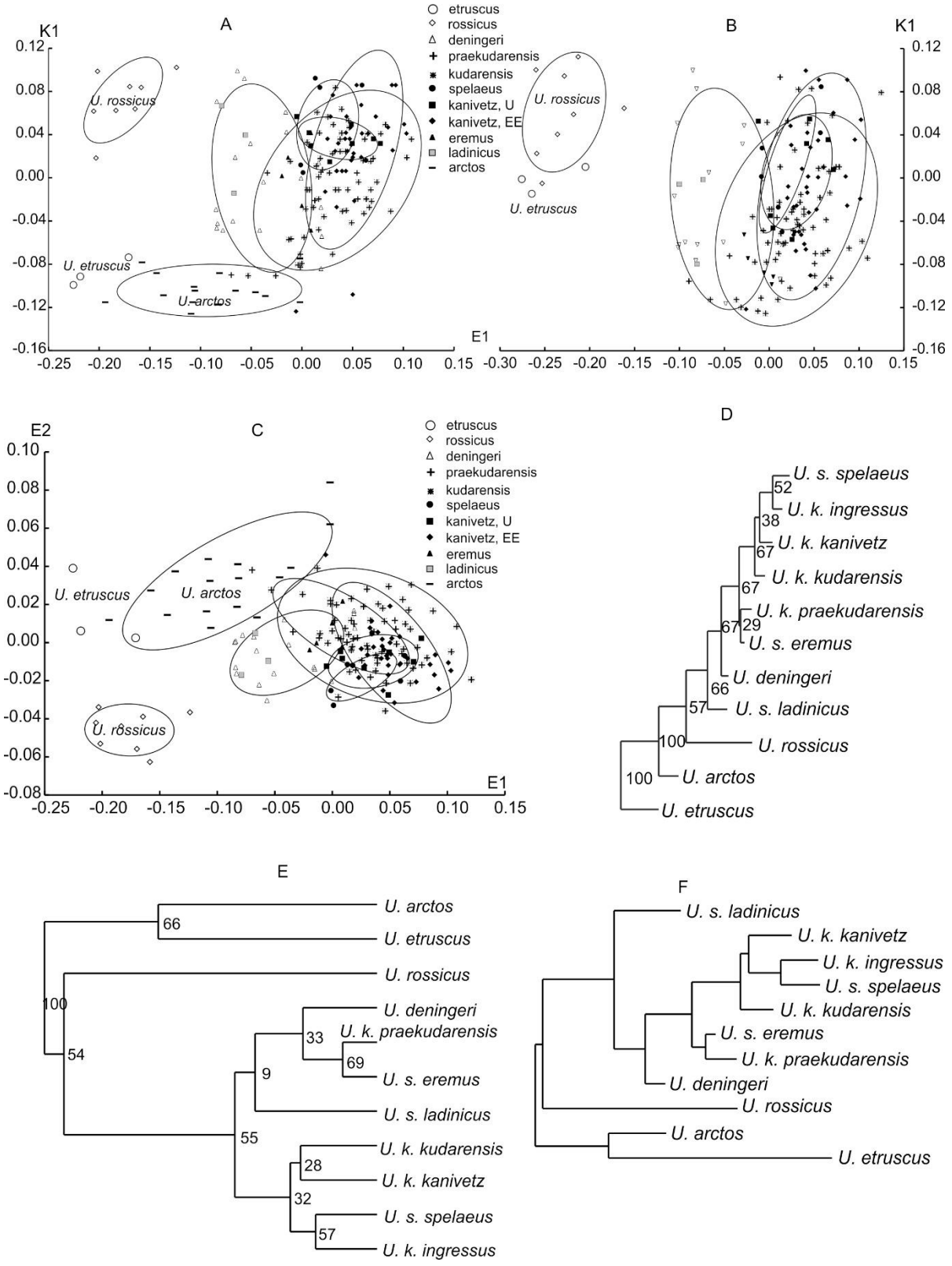


Fig. S24. Scatterplot of the first dimensions of "size" and "shape" morphospaces reproduced variation of mtc V in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.88); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" and "shape" morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projections onto the axes are equal to the "sample mean" (centroid) ± "highest value - " x 0.95.

## Females

Table S35. Description of the modeled morphological spaces for females of cave bears and brown bear mtc V. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.76 | 0.58 | -0.56 | 0.17 | 0.90 | 0.91 | -0.27 | 0.23 | -0.41 | 0.88 |
| Bp | 0.94 | -0.04 | -0.25 | 0.05 | 0.89 | 0.92 | -0.07 | 0.22 | -0.38 | 0.86 |
| Dp | 0.95 | -0.07 | -0.30 | -0.04 | 0.89 | 0.92 | -0.12 | 0.38 | -0.11 | 0.89 |
| SD | 0.90 | -0.30 | 0.04 | 0.02 | 0.95 | 0.87 | 0.33 | -0.15 | -0.20 | 0.95 |
| Bd | 0.91 | -0.23 | -0.12 | -0.28 | 0.95 | 0.88 | -0.16 | 0.19 | 0.00 | 0.86 |
| Dd | 0.96 | 0.07 | -0.43 | -0.08 | 0.95 | 0.94 | -0.20 | 0.28 | -0.30 | 0.89 |
| ip | -0.10 | -0.69 | 0.42 | -0.64 | 0.88 | -0.08 | 0.33 | 0.06 | 0.70 | 0.52 |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 76.6 | 64.7 | 59.5 | 6.0 | | 68.4 | 15.4 | 4.0 | 32.9 | |

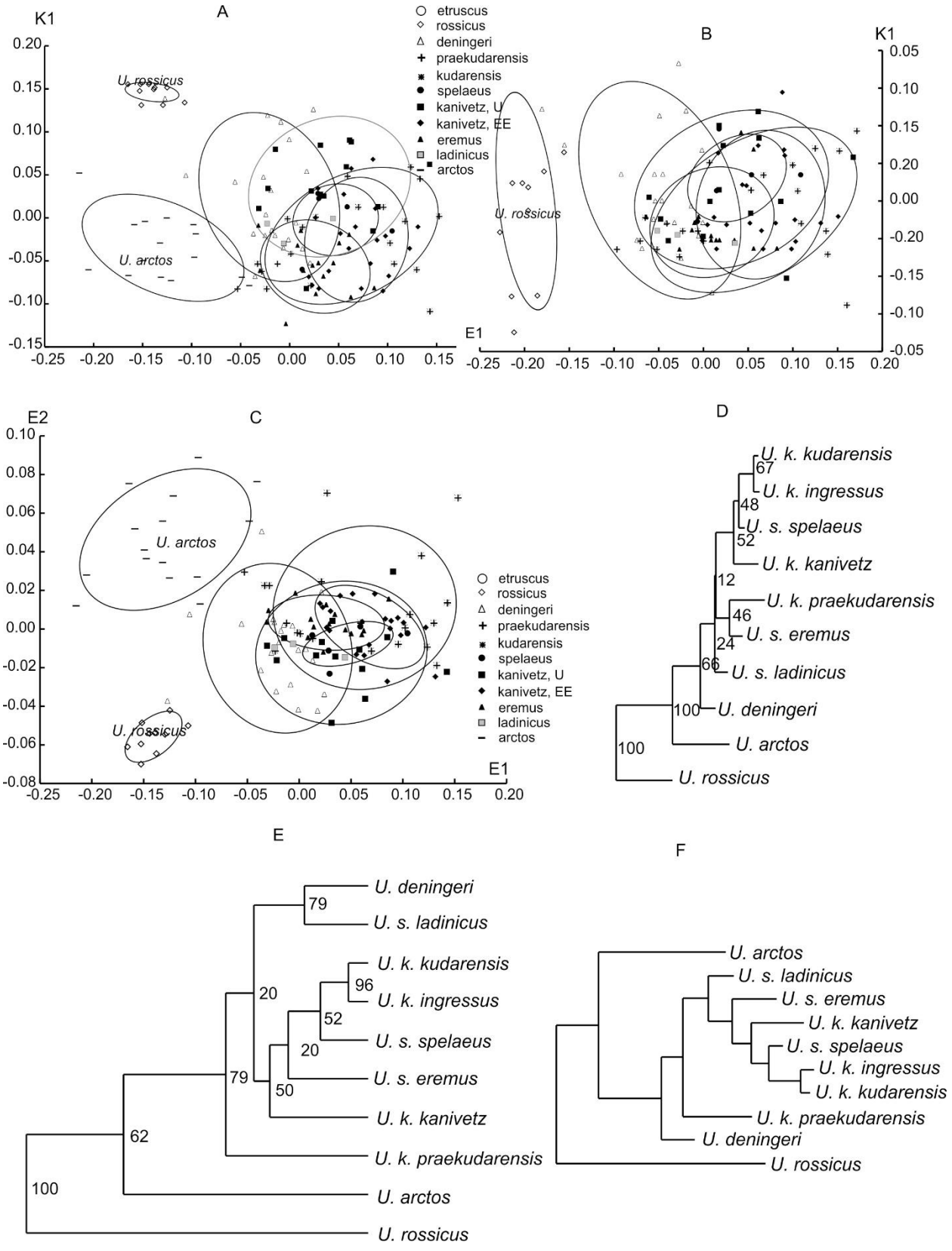


Fig. S25. Scatterplot of the first dimensions of "size" and "shape" morphospaces reproduced variation of mtc V in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.95); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" and "shape" morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projections onto the axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# Supplement II

## Additional materials to

**Gennady F. Baryshnikov, Andrei Yu. Puzachenko**

## Morphometrical analysis of metacarpal and metatarsal bones of cave bears (Carnivora, Ursidae)

Content

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# METATARSAL BONE I (MTT I)

## Males and females

Table S1. Sample numbers (N), means (M), and standard errors (m) of the variables of mtt I among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. deningeri* | 30 | 55.5±0.68 | 30 | 23.9±0.44 | 30 | 25.9±0.62 | 30 | 12.2±0.26 |
| *U. k. praekudarensis* | 26 | 61.2±0.91 | 27 | 26.4±0.51 | 28 | 26.5±0.56 | 29 | 13.5±0.24 |
| *U. k. kudarensis* | 96 | 60.7±0.40 | 95 | 26.7±0.17 | 102 | 29.2±0.26 | 100 | 13.3±0.10 |
| *U. rossicus* | 13 | 42.2±0.48 | 10 | 16.5±0.26 | 10 | 17.0±0.57 | 10 | 8.6±0.20 |
| *U. s. spelaeus* | 12 | 54.7±1.09 | 11 | 23.1±0.70 | 12 | 25.6±0.86 | 12 | 11.5±0.36 |
| *U. k. kanivetz* | 13 | 54.5±1.03 | 12 | 22.9±0.59 | 13 | 24.8±0.44 | 13 | 11.3±0.26 |
| *U. s. eremus* | 20 | 54.0±0.77 | 20 | 22.4±0.54 | 20 | 25.2±0.65 | 20 | 11.2±0.38 |
| *U. k. ingressus* | 38 | 56.6±0.56 | 13 | 24.3±0.58 | 13 | 23.8±0.66 | 38 | 17.5±0.25 |
| *U. arctos* | 24 | 64.8±1.51 | 24 | 20.8±0.59 | 18 | 21.7±0.93 | 24 | 9.7±0.37 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. deningeri* | 30 | 17.6±0.31 | 30 | 15.5±0.24 |
| *U. k. praekudarensis* | 28 | 19.6±0.29 | 28 | 16.6±0.23 |
| *U. k. kudarensis* | 98 | 19.5±0.14 | 94 | 15.9±0.11 |
| *U. rossicus* | 13 | 13.5±0.29 | 9 | 11.3±0.18 |
| *U. s. spelaeus* | 11 | 17.6±0.49 | 11 | 16.2±0.37 |
| *U. k. kanivetz* | 13 | 17.2±0.41 | 13 | 15.6±0.27 |
| *U. s. eremus* | 20 | 16.7±0.37 | 20 | 16.0±0.33 |
| *U. k. ingressus* | 38 | 17.5±0.25 | 31 | 16.7±0.22 |
| *U. arctos* | 24 | 16.2±0.55 | 17 | 13.7±0.47 |

### Sexual size dimorphism

Table S2. Sexual size dimorphism (SSD and ASSD) of mtt I in the different forms of cave bears and brown bear; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 57.1±0.69 | 25.3±0.39 | 27.9±0.60 | 13.1±0.28 | 18.5±0.26 | 16.3±0.20 | |
| Females | 53.1±1.04 | 21.7±0.45 | 23.0±0.62 | 10.8±0.21 | 16.1±0.36 | 14.4±0.31 | |
| *SSD* | 3.7±1.13 ($p$=0.004) | 7.8±1.27 ($p$<0.001) | 9.6±1.71 ($p$<0.001) | 9.5±1.48 ($p$<0.001) | 7.0±1.30 ($p$<0.001) | 6.0±1.20 ($p$ <0.001) | 7.3 |
| *v, %* | 42.2 | 71.3 | 66.8 | 70.5 | 67.2 | 65.0 | |
| | | | | *U. rossicus* | | | |
| Males | 43.9±0.29 | 17.0±0.43 | 18.9±1.06 | 9.1±0.29 | 14.7±0.22 | 11.6±0.42 | |
| Females | 41.2±0.45 | 16.3±0.31 | 16.1±0.41 | 8.4±0.21 | 12.7±0.1 | 11.2±0.18 | |
| *SSD* | 3.2±0.63 ($p$=0.004) | n.s. | n.s. | n.s. | 7.1±0.89 ($p$=0.004) | n.s. | 4.4 |
| *v, %* | 69.5 | - | - | - | 92.0 | - | |
| | | | | *U. k. praekudarensis* | | | |
| Males | 63.1±0.65 | 27.4±0.4 | 27.3±0.56 | 13.9±0.21 | 20.0±0.21 | 17.2±0.15 | |
| Females | 55.0±1.61 | 22.9±0.81 | 23.4±0.86 | 12.1±0.56 | 17.8±0.86 | 14.8±0.31 | |
| *SSD* | 6.8±1.48 | 8.9±1.8 | 7.7±2.03 | 6.7±2.30 | 5.8±2.33 | 7.5±1.08 | 7.2 |

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | (p<0.001) | (*p*<0.001) | (*p*=0.006) | (*p*=0.01) | (*p* =0.02) | (*p*<0.001) | |
| *v, %* | 75.6 | 72.4 | 55.6 | 51.8 | 54.6 | 84.2 | |
| | | | | *U. k. kudarensis* | | | |
| Males | 66.1±0.44 | 27.5±0.19 | 30.7±0.26 | 13.8±0.10 | 20.0±0.17 | 16.3±0.15 | |
| Females | 61.9±0.55 | 26.1±0.25 | 27.8±0.35 | 12.9±0.15 | 19.0±0.20 | 15.5±0.13 | |
| *SSD* | 3.3±0.37 | 2.5±0.58 | 5.0±0.74 | 3.2±0.67 | 2.7±0.66 | 2.5±0.62 | 3.3 |
| | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | |
| *v, %* | 72.7 | 23.7 | 45.2 | 28.0 | 23.1 | 19.7 | |
| | | | | *U. s. spelaeus* | | | |
| Males | 59.2±0.78 | 25.6±0.56 | 28.1±0.56 | 12.9±0.32 | 19.1±0.41 | 17.5±0.35 | |
| Females | 52.5±0.74 | 21.7±0.54 | 24.4±1.02 | 10.8±0.28 | 16.8±0.52 | 15.4±0.26 | |
| *SSD* | 6.0±0.96 | 8.2±1.64 | 7.0±2.22 | 8.8±1.80 | 6.4±1.84 | 6.3±1.32 | 7.1 |
| | (*p*=0.008) | (*p*=0.01) | n.s. | (*p*=0.008) | (*p*=0.02) | (*p*=0.01) | |
| *v, %* | 83.4 | 80.5 | 47.7 | 76.7 | 61.4 | 81.0 | |
| | | | | *U. s. eremus* | | | |
| Males | 56.9±0.60 | 24.4±0.61 | 27.3±0.79 | 12.5±0.43 | 18.1±0.39 | 17.1±0.38 | |
| Females | 51.1±0.58 | 20.5±0.23 | 23.1±0.40 | 9.8±0.16 | 15.4±0.19 | 14.9±0.19 | |
| *SSD* | 5.3±0.77 | 8.5±1.46 | 8.4±1.76 | 12.0±2.05 | 7.9±1.30 | 7.0±1.32 | 8.2 |
| | (p<0.001) | (*p*<0.001) | (*p*=0.002) | (*p*<0.001) | (*p*<0.001) | (*p*=0.002) | |
| *v, %* | 82.3 | 76.7 | 68.4 | 77.0 | 78.4 | 73.2 | |
| | | | | *U. k. ingressus* | | | |
| Males | 59.6±0.47 | 25.4±0.62 | 24.0±0.95 | 12.9±0.29 | 18.8±0.21 | 17.5±0.20 | |
| Females | 54.2±0.52 | 22.6±0.61 | 23.5±0.92 | 11.1±0.20 | 16.5±0.25 | 15.8±0.26 | |
| *SSD* | 4.7±0.62 | 5.8±1.81 | | 7.4±1.48 | 6.5±0.93 | 5.0±0.98 | 5.1 |
| | (p<0.001) | (*p*=0.004) | n.s. | (*p*<0.001) | (p<0.001) | (*p*<0.001) | |
| *v, %* | 76.0 | 56.9 | - | 11.5 | 69.3 | 80.2 | |
| | | | | *U. kanivetz* | | | |
| Males | 57.7±0.88 | 25.0±0.20 | 25.8±0.60 | 12.0±0.23 | 18.2±0.67 | 16.4±0.20 | |
| Females | 51.7±0.81 | 21.4±0.45 | 24.0±0.46 | 10.8±0.32 | 16.3±0.18 | 15.0±0.27 | |
| *SSD* | 5.5±1.01 | 7.7±1.06 | | 5.3±1.71 | 5.5±2.01 | 4.7±1.08 | 5.4 |
| | (*p*=0.003) | (*p*=0.006) | n.s. | (*p*=0.02) | (*p*=0.01) | (*p*=0.006) | |
| *v, %* | 77.9 | 87.0 | | 56.3 | 70.9 | 69.3 | |
| | | | | *U. arctos* | | | |
| Males | 70.2±1.79 | 23.3±0.55 | 23.9±1.32 | 11.1±0.50 | 18.5±0.64 | 15.3±0.49 | |
| Females | 60.2±1.44 | 18.6±0.44 | 19.5±0.84 | 8.5±0.24 | 14.3±0.37 | 12.4±0.37 | |
| *SSD* | 7.6±1.75 | 11.1±1.70 | 10.3±3.62 | 13.1±2.84 | 12.8±2.26 | 10.5±2.24 | 10.9 |
| | (*p*<0.001) | (*p*<0.001) | (p=0.01) | (p<0.001) | (*p*=0.004) | (*p*=0.001) | |

**Univariate analysis**

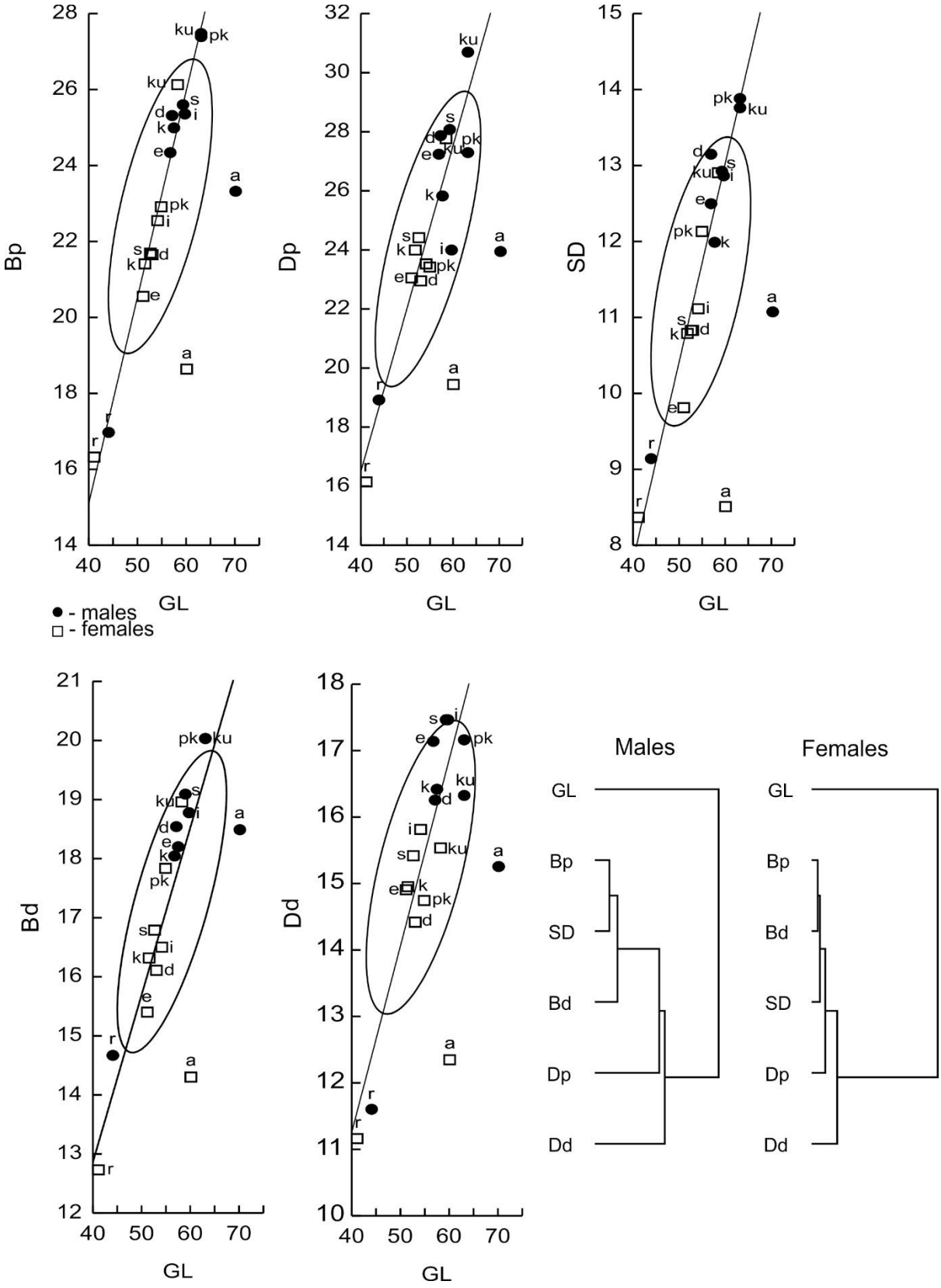


Fig. S1. The scatterplots of measures (GL – Dd) of mtt I and their UPMGA classification: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*.

Table S3. Statistical parameters of measures of mtt I among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | GL Std.Dev. | Bp - N | Bp | Bp Std.Dev. | Dp - N | Dp | Dp Std.Dev. | SD - N | SD | SD Std.Dev. | Bd - N | Bd | Bd Std.Dev. | Dd- N | Dd | Dd Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. rossicus* | f | 8 | 41.2 | 1.26 | 7 | 16.3 | 0.83 | 7 | 16.1 | 1.08 | 7 | 8.4 | 0.56 | 8 | 12.7 | 0.27 | 6 | 11.2 | 0.45 |
| | m | 5 | 43.9 | 0.66 | 3 | 17.0 | 0.75 | 3 | 18.9 | 1.84 | 3 | 9.1 | 0.50 | 5 | 14.7 | 0.50 | 3 | 11.6 | 0.72 |
| *U. deningeri* | f | 12 | 53.1 | 3.60 | 12 | 21.7 | 1.56 | 12 | 23.0 | 2.15 | 12 | 10.8 | 0.72 | 12 | 16.1 | 1.26 | 12 | 14.4 | 1.07 |
| | m | 18 | 57.1 | 2.91 | 18 | 25.3 | 1.66 | 18 | 27.9 | 2.55 | 18 | 13.1 | 1.21 | 18 | 18.5 | 1.12 | 18 | 16.3 | 0.85 |
| *U. k. praekudarensis* | f | 6 | 55.0 | 3.95 | 6 | 22.9 | 1.98 | 6 | 23.4 | 2.11 | 6 | 12.1 | 1.37 | 6 | 17.8 | 2.10 | 6 | 14.8 | 0.75 |
| | m | 20 | 63.1 | 2.93 | 21 | 27.4 | 1.85 | 22 | 27.3 | 2.60 | 23 | 13.9 | 1.02 | 22 | 20.0 | 0.97 | 22 | 17.2 | 0.70 |
| *U. k. kudarensis* | f | 50 | 58.4 | 2.05 | 51 | 26.1 | 1.76 | 53 | 27.8 | 2.54 | 51 | 12.9 | 1.05 | 49 | 19.0 | 1.37 | 49 | 15.5 | 0.88 |
| | m | 46 | 63.3 | 2.28 | 44 | 27.5 | 1.25 | 49 | 30.7 | 1.79 | 49 | 13.8 | 0.69 | 49 | 20.0 | 1.17 | 45 | 16.3 | 1.02 |
| *U. s. spelaeus* | f | 8 | 52.5 | 2.09 | 7 | 21.7 | 1.42 | 8 | 24.4 | 2.88 | 8 | 10.8 | 0.79 | 7 | 16.8 | 1.37 | 7 | 15.4 | 0.68 |
| | m | 4 | 59.2 | 1.56 | 4 | 25.6 | 1.11 | 4 | 28.1 | 1.13 | 4 | 12.9 | 0.64 | 4 | 19.1 | 0.82 | 4 | 17.5 | 0.70 |
| *U. k. ingressus* | f | 21 | 54.2 | 2.39 | 5 | 22.6 | 1.36 | 5 | 23.5 | 2.06 | 21 | 11.1 | 0.91 | 21 | 16.5 | 1.15 | 15 | 15.8 | 0.99 |
| | m | 17 | 59.6 | 1.93 | 8 | 25.4 | 1.75 | 8 | 24.0 | 2.70 | 17 | 12.9 | 1.21 | 17 | 18.8 | 0.86 | 16 | 17.5 | 0.81 |
| *U. k. kanivetz* | f | 7 | 51.7 | 2.14 | 7 | 21.4 | 1.19 | 7 | 24.0 | 1.21 | 7 | 10.8 | 0.84 | 7 | 16.3 | 0.49 | 7 | 15.0 | 0.72 |
| | m | 6 | 57.7 | 2.17 | 5 | 25.0 | 0.45 | 6 | 25.8 | 1.47 | 6 | 12.0 | 0.56 | 6 | 18.2 | 1.64 | 6 | 16.4 | 0.49 |
| *U. s. eremus* | f | 10 | 51.1 | 1.84 | 10 | 20.5 | 0.72 | 10 | 23.1 | 1.26 | 10 | 9.8 | 0.51 | 10 | 15.4 | 0.59 | 10 | 14.9 | 0.61 |
| | m | 10 | 56.9 | 1.89 | 10 | 24.4 | 1.94 | 10 | 27.3 | 2.49 | 10 | 12.5 | 1.35 | 10 | 18.1 | 1.23 | 10 | 17.1 | 1.19 |
| *U. arctos* | f | 13 | 60.2 | 5.08 | 13 | 18.6 | 1.59 | 9 | 19.5 | 2.52 | 13 | 8.5 | 0.86 | 13 | 14.3 | 1.32 | 9 | 12.4 | 1.12 |
| | m | 11 | 70.2 | 5.93 | 11 | 23.3 | 1.84 | 9 | 23.9 | 3.96 | 11 | 11.1 | 1.65 | 11 | 18.5 | 2.11 | 8 | 15.3 | 1.39 |

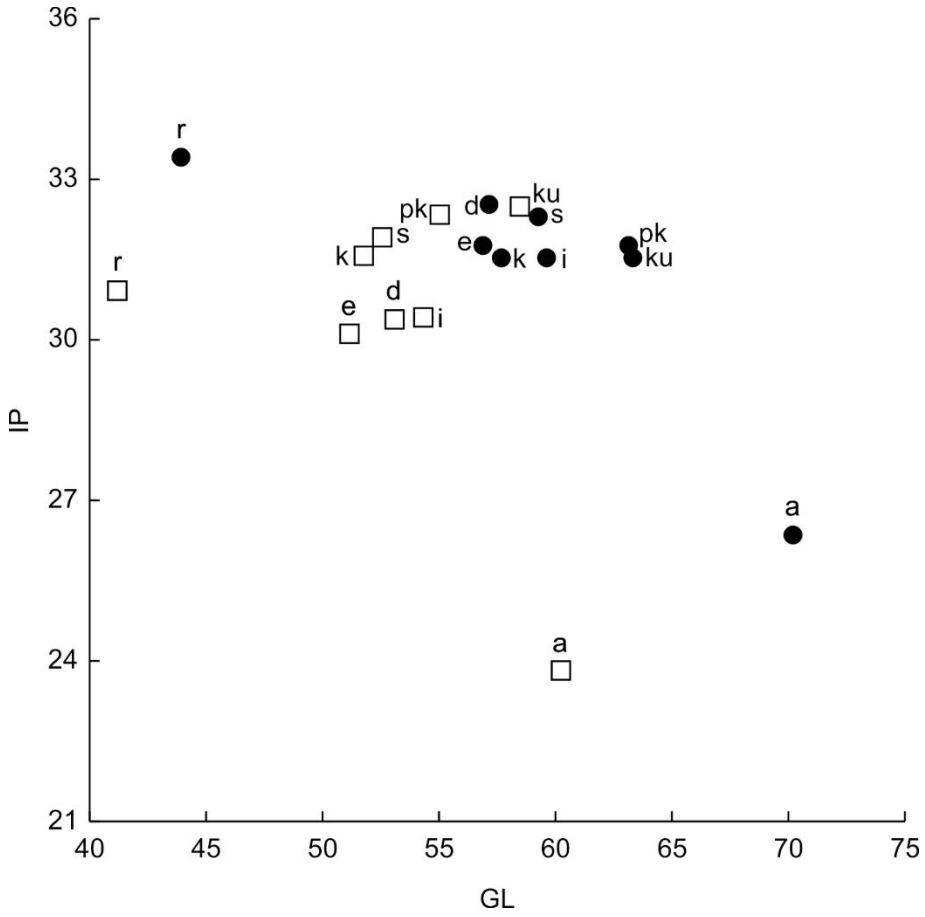


Fig. S2. The scatterplot of Index plumpness (ip) and GL of mtt I: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, sa – *U. savini*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females

Table S4. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtt I. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | |
| *U. deningeri* | 1 | | 1.32 | 4.6 | 5.79 | 0.64 | 1.57 | 0.11 | 0.37 | 6.23 |
| *U. rossicus* | 2 | 2.32 | | 4.33 | 4.84 | 1.52 | 2.36 | 1.19 | 0.96 | 5.66 |
| *U. k. praekudarensis* | 3 | 0.97 | 2.86 | | 0.43 | 2.09 | 2.92 | 3.1 | 4.23 | 2.37 |
| *U. k. kudarensis* | 4 | 4.01 | 6.17 | 1.86 | | 2.41 | 3.8 | 3.59 | 5.03 | 2.31 |
| *U. s. spelaeus* | 5 | 0.44 | 1.72 | 1.27 | 3.92 | | 0.33 | 0.46 | 0.84 | 3.48 |
| *U. k. ingressus* | 6 | 0.61 | 3.09 | 0.56 | 4.10 | 1.02 | | 1.01 | 1.7 | 4.79 |
| *U. k. kanivetz* | 7 | 0.62 | 1.48 | 1.40 | 3.92 | 0.18 | 1.18 | | 0.38 | 4.59 |
| *U. s. eremus* | 8 | 0.99 | 1.34 | 1.76 | 4.94 | 0.47 | 1.68 | 0.26 | | 5.79 |
| *U. arctos* | 9 | 3.91 | 5.84 | 2.19 | 0.89 | 3.94 | 3.81 | 3.97 | 4.73 | |
| | | | | | Bp | | | | | |
| *U. deningeri* | 1 | | 1.96 | 3.07 | 4.15 | 0.16 | 0.26 | 0.60 | 0.80 | 1.81 |
| *U. rossicus* | 2 | 2.49 | | 3.58 | 4.00 | 1.72 | 1.97 | 1.26 | 1.38 | 0.82 |
| *U. k. praekudarensis* | 3 | 0.68 | 2.74 | | 0.66 | 1.64 | 2.11 | 2.59 | 3.38 | 4.51 |
| *U. k. kudarensis* | 4 | 4.14 | 6.23 | 2.28 | | 2.05 | 2.74 | 3.10 | 4.21 | 5.50 |
| *U. s. spelaeus* | 5 | 0.01 | 2.22 | 0.61 | 3.28 | | 0.03 | 0.58 | 0.68 | 1.34 |
| *U. k. ingressus* | 6 | 0.51 | 2.49 | 0.12 | 2.25 | 0.46 | | 0.72 | 0.89 | 1.72 |
| *U. k. kanivetz* | 7 | 0.20 | 2.04 | 0.78 | 3.52 | 0.18 | 0.62 | | 0.02 | 0.72 |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| *U. s. eremus* | 8 | 0.94 | 1.59 | 1.44 | 5.00 | 0.82 | 1.23 | 0.63 | | 0.86 |
| *U. arctos* | 9 | 2.06 | 0.77 | 2.36 | 6.92 | 1.76 | 2.08 | 1.56 | 1.00 | |
| | | | | | Dp | | | | | |
| *U. deningeri* | 1 | | 2.37 | 0.46 | 3.76 | 0.06 | 2.24 | 1.49 | 0.36 | 2.02 |
| *U. rossicus* | 2 | 2.21 | | 2.16 | 4.23 | 1.98 | 0.78 | 1.10 | 2.03 | 0.98 |
| *U. k. praekudarensis* | 3 | 0.10 | 1.98 | | 4.61 | 0.33 | 1.95 | 1.20 | 0.01 | 1.72 |
| *U. k. kudarensis* | 4 | 4.25 | 5.99 | 3.04 | | 1.93 | 5.22 | 4.02 | 3.40 | 5.14 |
| *U. s. spelaeus* | 5 | 0.83 | 2.77 | 0.61 | 2.58 | | 1.61 | 1.14 | 0.30 | 1.43 |
| *U. k. ingressus* | 6 | 0.15 | 1.93 | 0.05 | 2.73 | 0.53 | | 0.47 | 1.71 | 0.26 |
| *U. k. kanivetz* | 7 | 0.53 | 2.43 | 0.36 | 2.76 | 0.25 | 0.29 | | 1.08 | 0.24 |
| *U. s. eremus* | 8 | 0.14 | 2.01 | 0.21 | 4.12 | 0.93 | 0.26 | 0.63 | | 1.49 |
| *U. arctos* | 9 | 1.59 | 0.70 | 1.42 | 5.71 | 2.23 | 1.40 | 1.89 | 1.39 | |
| | | | | | SD | | | | | |
| *U. deningeri* | 1 | | 2.51 | 1.93 | 2.08 | 0.48 | 0.43 | 2.10 | 0.93 | 2.78 |
| *U. rossicus* | 2 | 2.40 | | 3.54 | 3.60 | 1.70 | 2.27 | 0.82 | 1.82 | 0.78 |
| *U. k. praekudarensis* | 3 | 1.62 | 3.51 | | 0.13 | 1.61 | 2.35 | 3.48 | 2.57 | 4.55 |
| *U. k. kudarensis* | 4 | 3.92 | 5.96 | 1.04 | | 1.61 | 2.55 | 3.61 | 2.71 | 4.90 |
| *U. s. spelaeus* | 5 | 0.01 | 2.20 | 1.51 | 3.32 | | 0.22 | 1.12 | 0.17 | 1.36 |
| *U. k. ingressus* | 6 | 0.44 | 2.99 | 1.41 | 4.24 | 0.40 | | 1.78 | 0.56 | 2.38 |
| *U. k. kanivetz* | 7 | 0.11 | 2.04 | 1.55 | 3.26 | 0.09 | 0.49 | | 1.20 | 0.15 |
| *U. s. eremus* | 8 | 1.45 | 1.06 | 2.77 | 5.44 | 1.30 | 2.04 | 1.16 | | 1.59 |
| *U. arctos* | 9 | 2.68 | 0.15 | 3.82 | 7.50 | 2.38 | 3.49 | 2.17 | 1.07 | |
| | | | | | Bd | | | | | |
| *U. deningeri* | 1 | | 2.13 | 3.71 | 4.08 | 0.83 | 0.51 | 0.34 | 0.54 | 0.79 |
| *U. rossicus* | 2 | 2.53 | | 4.56 | 4.69 | 2.29 | 2.46 | 1.52 | 1.58 | 2.56 |
| *U. k. praekudarensis* | 3 | 1.55 | 3.57 | | 0.22 | 1.32 | 3.12 | 2.91 | 3.66 | 2.38 |
| *U. k. kudarensis* | 4 | 4.22 | 6.59 | 1.35 | | 1.27 | 3.37 | 2.97 | 3.86 | 2.47 |
| *U. s. spelaeus* | 5 | 0.65 | 2.83 | 0.84 | 2.60 | | 0.52 | 0.96 | 1.14 | 0.28 |
| *U. k. ingressus* | 6 | 0.52 | 3.23 | 1.27 | 4.49 | | | 0.70 | 0.98 | 0.33 |
| *U. k. kanivetz* | 7 | 0.10 | 2.33 | 1.30 | 3.24 | 0.28 | | | 0.11 | 0.91 |
| *U. s. eremus* | 8 | 1.09 | 1.45 | 2.40 | 5.26 | 0.49 | 0.32 | 1.05 | | 1.18 |
| *U. arctos* | 9 | 1.84 | 0.93 | 3.06 | 6.71 | 1.57 | 1.70 | 1.68 | 0.64 | |
| | | | | | Dd | | | | | |
| *U. deningeri* | 1 | | 2.18 | 2.75 | 0.00 | 2.24 | 3.38 | 0.11 | 2.19 | 1.38 |
| *U. rossicus* | 2 | 2.24 | | 3.63 | 2.28 | 3.41 | 4.01 | 2.00 | 3.38 | 1.14 |
| *U. k. praekudarensis* | 3 | 0.31 | 2.21 | | 3.37 | 0.67 | 0.87 | 1.79 | 0.03 | 3.54 |
| *U. k. kudarensis* | 4 | 2.84 | 4.71 | 1.76 | | 2.38 | 4.00 | 0.12 | 2.47 | 1.53 |
| *U. s. spelaeus* | 5 | 1.77 | 3.53 | 1.23 | 0.18 | | 0.14 | 1.84 | 0.64 | 2.98 |
| *U. k. ingressus* | 6 | 3.08 | 4.79 | 2.15 | 0.94 | 0.76 | | 2.32 | 0.74 | 4.04 |
| *U. k. kanivetz* | 7 | 0.65 | 2.57 | 0.27 | 1.51 | 1.00 | 1.93 | | 1.57 | 1.18 |
| *U. s. eremus* | 8 | 0.53 | 2.61 | 0.14 | 1.99 | 1.25 | 2.37 | 0.16 | | 3.06 |
| *U. arctos* | 9 | 2.06 | 0.40 | 2.02 | 5.04 | 3.48 | 4.99 | 2.42 | 2.47 | |

## Multivariate analyses

Table S5. Description of the modeled morphological spaces for cave bears and brown bear mtt I. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E3, K1–K3); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | K3 | |
| GL | 0.86 | 0.35 | 0.11 | -0.35 | 0.74 | 0.88 | -0.21 | -0.14 | 0.21 | 0.36 | 0.91 |
| Bp | 0.95 | 0.18 | 0.30 | -0.53 | 0.93 | 0.95 | -0.02 | -0.28 | 0.45 | 0.20 | 0.93 |
| Dp | 0.86 | -0.26 | 0.58 | -0.15 | 0.96 | 0.85 | 0.38 | -0.52 | 0.08 | -0.12 | 0.97 |
| SD | 0.95 | 0.05 | 0.33 | -0.54 | 0.93 | 0.94 | 0.09 | -0.30 | 0.56 | -0.12 | 0.96 |
| Bd | 0.95 | 0.26 | 0.21 | -0.53 | 0.91 | 0.95 | -0.10 | -0.20 | 0.45 | 0.15 | 0.90 |
| Dd | 0.77 | 0.61 | -0.23 | -0.21 | 0.85 | 0.78 | -0.52 | 0.32 | 0.18 | -0.03 | 0.95 |
| ip | 0.37 | -0.12 | 0.29 | -0.38 | | 0.33 | 0.21 | -0.21 | 0.47 | -0.30 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 64.4 | 51.24 | 43.1 | 55.1 | | 68.2 | 41.0 | 51.7 | 23.5 | 12.6 | |

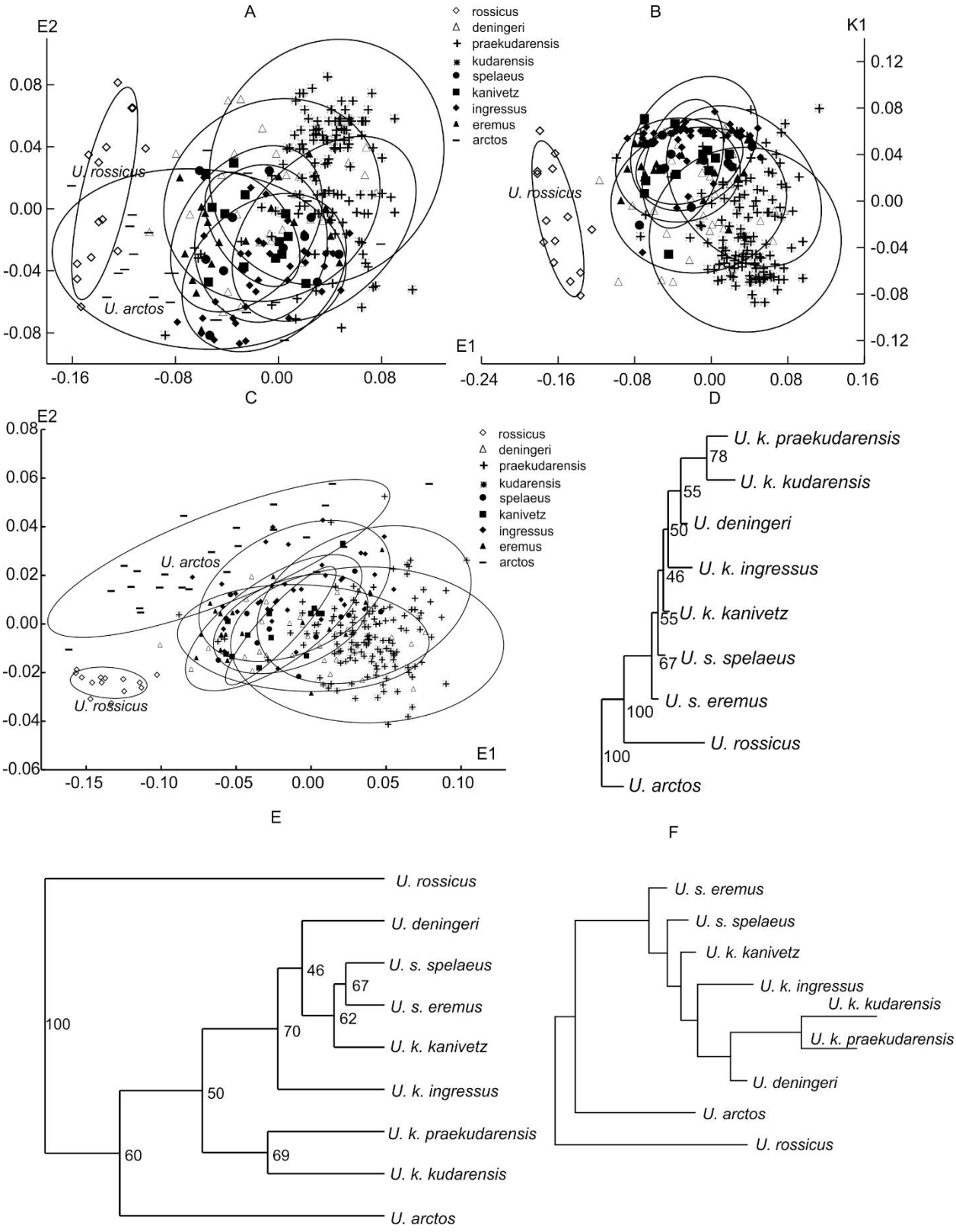


Fig. S3. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt I in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.89); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S6. Description of the modeled morphological spaces of mtt I for males of cave bears and brown bear. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | K3 | |
| GL | 0.51 | 0.47 | 0.05 | 0.45 | 0.66 | 0.79 | -0.25 | -0.13 | -0.45 | 0.29 | 0.89 |
| Bp | 0.91 | 0.01 | 0.22 | -0.04 | 0.84 | 0.91 | 0.03 | -0.15 | -0.03 | 0.47 | 0.84 |
| Dp | 0.81 | -0.45 | 0.57 | -0.31 | 0.88 | 0.75 | 0.58 | -0.56 | 0.20 | 0.02 | 0.94 |
| SD | 0.91 | -0.16 | 0.18 | -0.45 | 0.87 | 0.88 | 0.19 | -0.09 | 0.40 | 0.38 | 0.91 |
| Bd | 0.88 | 0.20 | 0.10 | 0.01 | 0.81 | 0.88 | -0.09 | -0.02 | -0.04 | 0.48 | 0.82 |
| Dd | 0.66 | 0.50 | -0.45 | -0.09 | 0.79 | 0.62 | -0.57 | 0.52 | -0.07 | -0.05 | 0.88 |
| ip | 0.13 | -0.05 | 0.02 | -0.13 | | 0.06 | -0.15 | -0.11 | -0.53 | 0.30 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 73.2 | 58.0 | 48.9 | 51.9 | | 82.5 | 48.6 | 58.4 | 7.7 | 29.7 | |

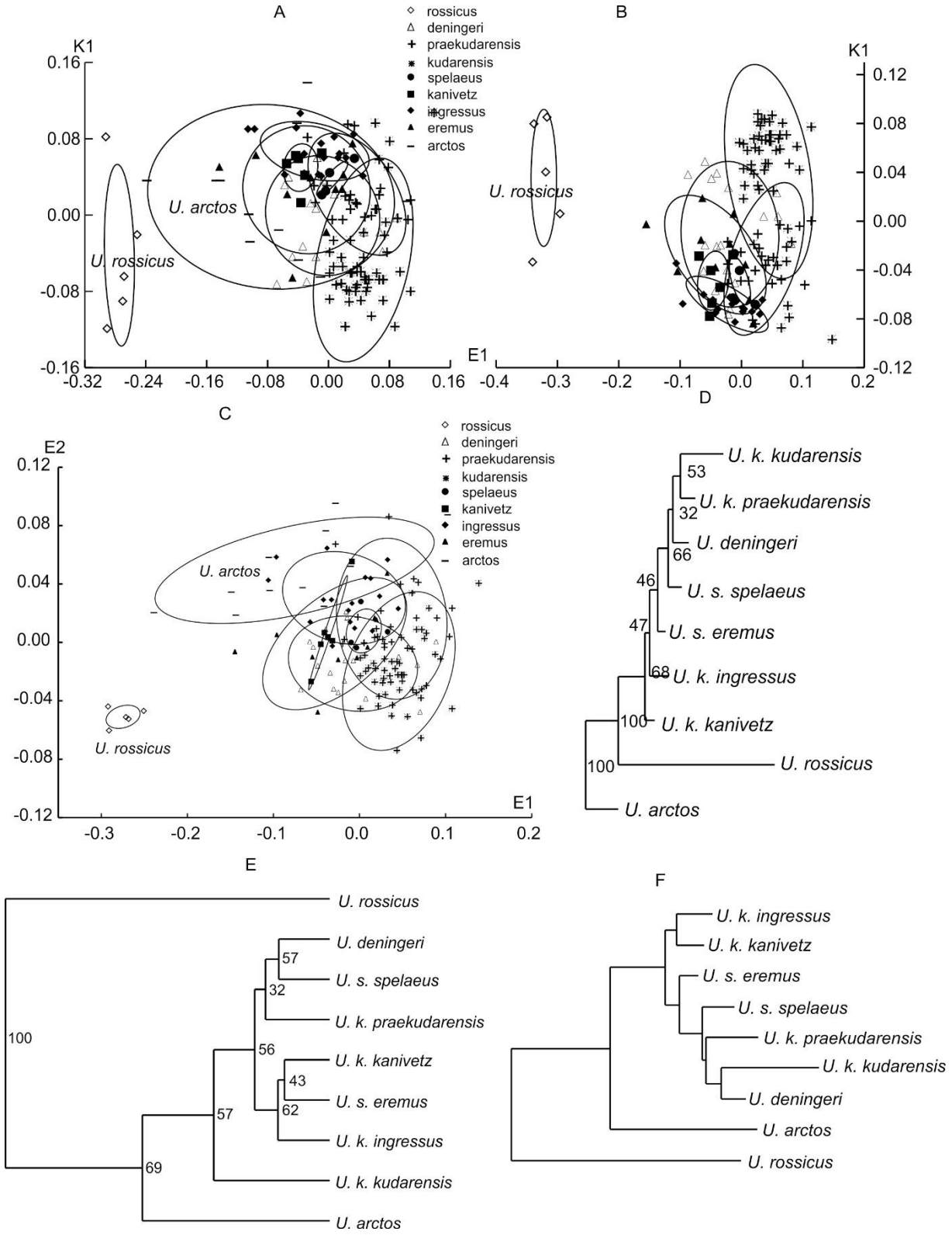


Fig. S4. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt I in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.98); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S7. Description of the modeled morphological spaces of mtt I for females of cave bears and brown bear. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | K3 | | E1 | E2 | K1 | K2 | |
| GL | 0.63 | 0.65 | -0.01 | -0.12 | 0.33 | 0.84 | 0.91 | -0.26 | -0.08 | 0.30 | 0.87 |
| Bp | 0.97 | 0.06 | 0.55 | -0.22 | 0.27 | 0.97 | 0.97 | -0.05 | -0.22 | 0.46 | 0.95 |
| Dp | 0.90 | -0.20 | 0.54 | 0.27 | 0.14 | 0.97 | 0.87 | 0.33 | -0.50 | 0.10 | 0.96 |
| SD | 0.95 | -0.13 | 0.70 | -0.20 | 0.00 | 0.97 | 0.94 | 0.10 | -0.23 | 0.52 | 0.92 |
| Bd | 0.96 | 0.09 | 0.52 | -0.21 | 0.19 | 0.92 | 0.96 | -0.10 | -0.13 | 0.39 | 0.91 |
| Dd | 0.83 | 0.17 | 0.22 | -0.18 | -0.13 | 0.81 | 0.80 | -0.46 | 0.22 | 0.01 | 0.89 |
| ip | 0.54 | -0.15 | -0.66 | 0.03 | 0.19 | | 0.50 | 0.34 | -0.25 | 0.24 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 84.7 | 56.1 | 34.1 | 12.7 | 24.2 | | 85.6 | 28.7 | 17.8 | 36.7 | |

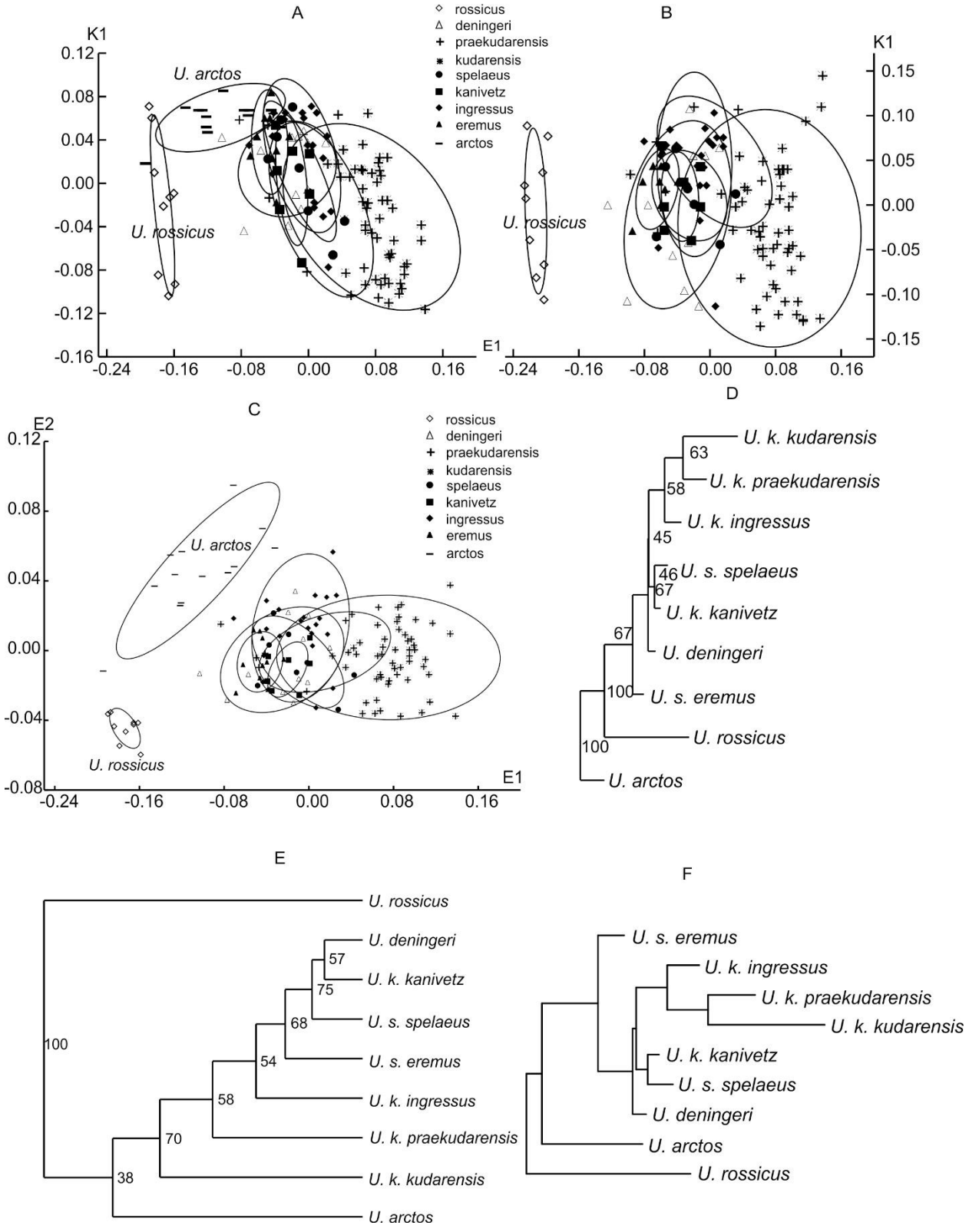


Fig. S5. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt I in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.90); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METATARSAL BONE II (MTT II)

## Males and females

Table S8. Sample numbers (N), means (M), and standard errors (m) of the variables of mtt II among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus* | 1 | 60.5 | | | | | 1 | 11.5 |
| *U. deningeri* | 35 | 65.6±0.65 | 35 | 15.0±0.21 | 35 | 23.5±0.26 | 35 | 12.8±0.19 |
| *U. k. praekudarensis* | 25 | 72.9±1.15 | 31 | 17.1±0.36 | 27 | 27.2±0.56 | 31 | 14.6±0.27 |
| *U. k. kudarensis* | 78 | 73.4±0.43 | 83 | 17.5±0.17 | 78 | 27.7±0.27 | 87 | 15.0±0.15 |
| *U. rossicus* | 17 | 51.5±0.52 | 14 | 11.2±0.29 | 12 | 18.5±0.28 | 14 | 10.1±0.09 |
| *U. s. spelaeus* | 18 | 67.9±0.69 | 18 | 15.3±0.69 | 15 | 23.5±0.54 | 18 | 13.6±0.24 |
| *U. k. kanivetz* | 19 | 68.3±1.07 | 19 | 15.9±0.30 | 17 | 23.9±0.40 | 19 | 13.8±0.26 |
| *U. s. eremus* | 20 | 69.3±0.93 | 20 | 15.2±0.38 | 20 | 25.2±0.50 | 20 | 13.4±0.33 |
| *U. s. ladinicus* | 11 | 65.8±0.99 | 11 | 15.1±0.36 | 11 | 24.1±0.55 | 11 | 13.6±0.36 |
| *U. k. ingressus* | 38 | 70.4±0.68 | 10 | 16.4±0.37 | 10 | 25.4±0.55 | 39 | 14.0±0.22 |
| *U. arctos* | 23 | 75.8±1.88 | 23 | 13.5±0.56 | 19 | 23.5±0.81 | 23 | 11.6±0.43 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus* | 1 | 17.1 | 1 | 12.1 |
| *U. deningeri* | 34 | 19.2±0.22 | 32 | 15.5±0.19 |
| *U. k. praekudarensis* | 29 | 22.1±0.38 | 25 | 17.5±0.34 |
| *U. k. kudarensis* | 82 | 22.8±0.21 | 67 | 17.5±0.13 |
| *U. rossicus* | 17 | 15.3±0.17 | 14 | 12.2±0.10 |
| *U. s. spelaeus* | 18 | 19.9±0.35 | 9 | 16.4±0.34 |
| *U. k. kanivetz* | 19 | 20.3±0.34 | 12 | 15.6±0.39 |
| *U. s. eremus* | 20 | 20.6±0.39 | 20 | 16.6±0.26 |
| *U. s. ladinicus* | 11 | 20.2±0.48 | 10 | 15.8±0.49 |
| *U. k. ingressus* | 38 | 20.4±0.30 | 26 | 16.8±0.24 |
| *U. arctos* | 23 | 17.8±0.53 | 20 | 15.1±0.46 |

* - female proposed

## Sexual dimorphism

Table S9. Sexual size dimorphism (SSD and ASSD) of mtt II in the different forms of cave bears and brown bear ; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 66.9±0.48 | 15.4±0.17 | 23.9±0.25 | 13.0±0.16 | 19.6±0.17 | 15.8±0.16 | |
| Females | 59.3±1.02 | 13.4±0.57 | 21.8±0.55 | 11.9±0.72 | 17.4±0.52 | 14.1±0.38 | |
| *SSD* | 6.0±0.89 ($p$<0.001) | 6.8±2.08 (p<0.001) | 4.6±1.32 ($p$ =0.003) | n.s. | 6.0±1.48 (p<0.001) | 5.6±1.38 (p<0.001) | 5.6 |
| *v, %* | 81.1 | 61.9 | 55.6 | 30.7 | 72.2 | 65.6 | |
| | | | | *U. rossicus* | | | |
| Males | 52.6±0.41 | 11.5±0.35 | 18.8±0.20 | 10.2±0.11 | 15.4±0.24 | 12.1±0.15 | |
| Females | 48.9±0.38 | 10.4±0.23 | 17.4±0.70 | 10.0±0.18 | 15.2±0.09 | 12.2±0.05 | |

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| *SSD* | 3.6±0.55 (p=0.002) | n.s. | n.s. | n.s. | n.s. | n.s. | 2.4 |
| *v, %* | 79.4 | - | - | - | - | - | |
| | | | *U. k. praekudarensis* | | | | |
| Males | 76.1±0.67 | 18.0±0.22 | 28.5±0.29 | 15.2±0.24 | 23.1±0.19 | 18.4±0.19 | |
| Females | 64.7±0.53 | 14.5±0.61 | 22.7±0.91 | 12.6±0.16 | 18.9±0.41 | 15.2±0.30 | |
| *SSD* | 8.1±0.61 (p<0.001) | 10.8±2.02 (p<0.001) | 11.3±1.88 (p<0.001) | 9.2±1.04 (p<0.001) | 10.1±1.09 (p<0.001) | 9.8±1.05 (p<0.001) | 9.9 |
| *v, %* | 91.6 | 78.1 | 92.8 | 75.2 | 90.4 | 89.0 | |
| | | | *U. k. kudarensis* | | | | |
| Males | 75.6±0.31 | 17.9±0.18 | 28.7±0.27 | 15.5±0.18 | 23.6±0.23 | 17.9±0.13 | |
| Females | 69.4±0.50 | 16.7±0.27 | 26.2±0.41 | 14.3±0.23 | 21.5±0.31 | 16.7±0.16 | |
| *SSD* | 4.3±0.41 (p<0.001) | 3.5±0.97 (*p*=0.004) | 4.6±0.89 (p<0.001) | 4.0±0.98 (p<0.001) | 4.5±0.86 (p<0.001) | 3.6±0.61 (p<0.001) | 4.1 |
| *v, %* | 77.3 | 18.5 | 50.3 | 14.2 | 25.8 | 47.6 | |
| | | | *U. s. spelaeus* | | | | |
| Males | 70.6±0.55 | 16.1±0.40 | 25.0±0.74 | 14.2±0.39 | 20.8±0.61 | 17.4±0.28 | |
| Females | 65.7±0.51 | 14.8±0.18 | 22.1±0.31 | 13.2±0.22 | 19.2±0.24 | 15.6±0.16 | |
| *SSD* | 3.6±0.55 (p<0.001) | 4.3±1.44 (p=0.003) | 6.2±1.70 (*p*=0.006) | 3.6±1.63 (*p*=0.03) | 4.1±1.63 (*p*=0.006) | 5.4±0.99 (p=0.02) | 4.5 |
| *v, %* | 68.9 | 29.7 | 79.7 | 39.2 | 40.5 | 87.8 | |
| | | | *U. s. ladinicus* | | | | |
| Males | 68.5±0.98 | 16.2±0.25 | 25.7±0.65 | 14.4±0.47 | 21.3±0.68 | 16.9±1.03 | |
| Females | 63.5±0.86 | 14.2±0.23 | 22.8±0.24 | 12.9±0.33 | 19.3±0.40 | 15.1±0.15 | |
| *SSD* | 3.8±0.99 (p=0.004) | 6.8±1.13 (p=0.004) | 6.0±1.43 (p=0.008) | 5.6±2.10 (p=0.03) | 5.1±1.94 (p=0.02) | 5.7±3.26 (p=0.02) | 5.5 |
| *v, %* | 67.6 | 85.7 | 74.4 | 46.6 | 58.0 | 44.0 | |
| | | | *U. s. eremus* | | | | |
| Males | 74.2±0.56 | 17.0±0.50 | 27.5±0.70 | 15.0±0.41 | 22.7±0.26 | 17.8±0.23 | |
| Females | 66.7±0.59 | 14.2±0.23 | 24.0±0.34 | 12.6±0.23 | 19.5±0.23 | 15.9±0.22 | |
| *SSD* | 5.3±0.58 (p<0.001) | 8.9±1.77 (p<0.001) | 6.8±1.51 (*p*=0.002) | 8.6±1.71 (p<0.001) | 7.5±0.86 (p<0.001) | 5.6±0.95 (p<0.001) | 7.13 |
| *v, %* | 88.1 | 78.5 | 73.5 | 76.2 | 87.4 | 75.5 | |
| | | | *U. k. ingressus* | | | | |
| Males | 75.2±0.51 | 17.5±0.40 | 27.2±0.55 | 15.5±0.30 | 22.5±0.34 | 17.8±0.16 | |
| Females | 68.0±0.51 | 15.7±0.28 | 24.2±0.29 | 13.3±0.16 | 19.3±0.18 | 15.9±0.23 | |
| *SSD* | 5.1±0.50 (p<0.001) | 5.5±1.48 (*p*=0.009) | 5.8±1.22 (p=0.009) | 7.7±1.18 (p=0.009) | 7.6±0.92 (p<0.001) | 5.7±0.82 (p=0.009) | 6.2 |
| *v, %* | 81.7 | 66.9 | 81.9 | 91.5 | 95.9 | 94.5 | |
| | | | *U. kanivetz* | | | | |
| Males | 73.7±1.59 | 17.1±0.26 | 25.0±0.30 | 14.7±0.39 | 21.9±0.21 | 16.9±0.81 | |
| Females | 65.9±0.65 | 15.3±0.31 | 23.5±0.50 | 13.4±0.27 | 19.6±0.32 | 15.0±0.24 | |
| *SSD* | 5.6±1.23 (p<0.001) | 5.6±1.23 (p=0.002) | n.s. | 4.5±1.69 (p=0.04) | 5.7±0.92 (p=0.04) | n.s. | 5.1 |
| *v, %* | 88.0 | 74.7 | - | 28.6 | 84.2 | - | |
| | | | *U. arctos* | | | | |
| Males | 80.3±2.18 | 15.1±0.61 | 26.1±0.78 | 12.8±0.50 | 19.4±0.59 | 16.5±0.47 | |
| Females | 68.9±1.85 | 11.5±0.52 | 20.7±0.70 | 10.0±0.31 | 15.7±0.38 | 13.5±0.37 | |
| *SSD* | 7.6±1.82 (*p*=) | 13.6±3.05 (*p*=) | 11.4±2.25 (p=) | 12.5±2.59 (*p*=) | 10.3±2.01 (*p*=) | 10.2±2.00 (*p*=) | 10.9 |

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| *v, %* | 48.4 | 78.1 | 72.4 | 75.2 | 76.1 | 68.1 | |

## Univariate statistic

Table S10. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtc II. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 1.52 | 5.81 | 6.98 | 1.02 | 4.60 | 2.39 | 2.85 | 0.34 | 6.46 |
| *U. rossicus* | 2 | 0.35 | | 6.07 | 6.69 | 2.04 | 5.13 | 3.19 | 3.62 | 1.29 | 6.69 |
| *U. k. praekudarensis* | 3 | 1.36 | 1.66 | | 0.41 | 3.14 | 0.57 | 1.42 | 1.21 | 3.12 | 1.14 |
| *U. k. kudarensis* | 4 | 4.99 | 5.06 | 3.51 | | 3.21 | 0.30 | 1.29 | 1.06 | 3.12 | 1.69 |
| *U. s. spelaeus* | 5 | 2.00 | 2.27 | 0.56 | 3.29 | | 2.51 | 1.23 | 1.53 | 0.43 | 3.89 |
| *U. k. ingressus* | 6 | 3.96 | 4.10 | 2.43 | 1.62 | 2.04 | | 0.94 | 0.71 | 2.60 | 1.58 |
| *U. k. kanivetz* | 7 | 2.33 | 2.59 | 0.83 | 3.26 | 0.28 | 1.90 | | 0.23 | 1.50 | 2.20 |
| *U. s. eremus* | 8 | 2.82 | 3.04 | 1.34 | 2.55 | 0.85 | 1.20 | 0.61 | | 1.77 | 2.04 |
| *U. s. ladinicus* | 9 | 0.86 | 1.17 | 0.47 | 3.88 | 1.04 | 2.86 | 1.32 | 1.81 | | 3.79 |
| *U. arctos* | 10 | 3.73 | 3.90 | 2.37 | 0.86 | 2.00 | 0.35 | 1.85 | 1.28 | 2.77 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 1.99 | 5.79 | 6.54 | 0.81 | 2.52 | 2.46 | 2.51 | 0.89 | 0.51 |
| *U. rossicus* | 2 | 1.29 | | 6.20 | 6.50 | 2.23 | 3.51 | 3.55 | 3.63 | 2.12 | 2.14 |
| *U. k. praekudarensis* | 3 | 0.97 | 2.21 | | 0.41 | 3.15 | 0.50 | 1.12 | 1.29 | 2.40 | 4.17 |
| *U. k. kudarensis* | 4 | 3.79 | 4.74 | 2.93 | | 3.13 | 0.32 | 0.95 | 1.13 | 2.31 | 4.34 |
| *U. s. spelaeus* | 5 | 1.40 | 2.63 | 0.42 | 2.65 | | 1.67 | 1.44 | 1.42 | 0.19 | 0.35 |
| *U. k. ingressus* | 6 | 2.27 | 3.32 | 1.46 | 0.84 | 1.14 | | 0.38 | 0.46 | 1.36 | 2.06 |
| *U. k. kanivetz* | 7 | 2.02 | 3.19 | 1.05 | 2.10 | 0.65 | 0.64 | | 0.08 | 1.11 | 1.89 |
| *U. s. eremus* | 8 | 0.73 | 2.08 | 0.37 | 4.02 | 0.86 | 1.93 | 1.62 | | 1.07 | 1.90 |
| *U. s. ladinicus* | 9 | 0.41 | 1.66 | 0.53 | 3.25 | 0.94 | 1.86 | 1.53 | 0.25 | | 0.50 |
| *U. arctos* | 10 | 1.07 | 0.47 | 2.27 | 6.16 | 2.85 | 3.61 | 3.68 | 2.17 | 1.53 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 1.70 | 6.03 | 7.29 | 0.92 | 2.08 | 0.67 | 3.09 | 1.12 | 2.08 |
| *U. rossicus* | 2 | 1.07 | | 5.96 | 6.50 | 2.05 | 2.93 | 1.74 | 3.86 | 2.13 | 3.06 |
| *U. k. praekudarensis* | 3 | 0.85 | 1.77 | | 0.05 | 3.08 | 1.13 | 2.82 | 0.98 | 2.39 | 2.52 |
| *U. k. kudarensis* | 4 | 4.14 | 4.32 | 3.04 | | 3.28 | 1.16 | 2.96 | 1.02 | 2.50 | 2.74 |
| *U. s. spelaeus* | 5 | 0.19 | 1.27 | 0.72 | 4.40 | | 1.16 | 0.10 | 1.71 | 0.27 | 0.76 |
| *U. k. ingressus* | 6 | 1.97 | 2.69 | 1.12 | 1.59 | 1.92 | | 1.17 | 0.30 | 0.85 | 0.59 |
| *U. k. kanivetz* | 7 | 1.58 | 2.40 | 0.59 | 3.12 | 1.50 | 0.71 | | 1.67 | 0.34 | 0.80 |
| *U. s. eremus* | 8 | 2.12 | 2.82 | 1.12 | 2.43 | 2.10 | 0.19 | 0.65 | | 1.30 | 1.09 |
| *U. s. ladinicus* | 9 | 0.81 | 1.74 | 0.05 | 3.10 | 0.68 | 1.17 | 0.64 | 1.18 | | 0.40 |
| *U. arctos* | 10 | 0.40 | 0.82 | 1.34 | 5.44 | 0.65 | 2.57 | 2.27 | 2.91 | 1.29 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 1.86 | 4.89 | 6.78 | 1.70 | 4.81 | 2.33 | 2.92 | 1.77 | 0.29 |
| *U. rossicus* | 2 | 1.20 | | 5.40 | 6.52 | 2.87 | 5.43 | 3.34 | 3.88 | 2.81 | 1.85 |
| *U. k. praekudarensis* | 3 | 0.39 | 1.58 | | 0.89 | 1.64 | 0.74 | 0.67 | 0.28 | 1.00 | 3.64 |
| *U. k. kudarensis* | 4 | 3.55 | 4.44 | 3.26 | | 2.34 | 0.11 | 1.22 | 0.84 | 1.52 | 4.75 |
| *U. s. spelaeus* | 5 | 1.36 | 2.49 | 0.98 | 2.43 | | 2.06 | 0.67 | 1.06 | 0.31 | 1.30 |
| *U. k. ingressus* | 6 | 1.81 | 2.97 | 1.41 | 2.89 | 0.33 | | 1.14 | 0.80 | 1.42 | 3.84 |
| *U. k. kanivetz* | 7 | 1.92 | 3.00 | 1.55 | 1.92 | 0.58 | 0.37 | | 0.34 | 0.31 | 1.92 |
| *U. s. eremus* | 8 | 0.47 | 1.76 | 0.03 | 4.11 | 1.11 | 1.73 | 1.82 | | 0.64 | 2.42 |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. s. ladinicus* | 9 | 0.87 | 1.97 | 0.51 | 2.42 | 0.38 | 0.70 | 0.90 | 0.55 | | 1.44 |
| *U. arctos* | 10 | 1.56 | 0.05 | 2.07 | 6.62 | 3.36 | 4.37 | 4.16 | 2.47 | 2.53 | |
| | | | | Bd | | | | | | | |
| *U. deningeri* | 1 | | 1.82 | 5.70 | 7.46 | 1.25 | 3.75 | 2.02 | 3.25 | 1.54 | 0.24 |
| *U. rossicus* | 2 | 0.91 | | 6.28 | 7.43 | 2.48 | 4.71 | 3.08 | 4.21 | 2.59 | 1.77 |
| *U. k. praekudarensis* | 3 | 1.19 | 2.07 | | 0.49 | 2.72 | 1.04 | 1.55 | 0.58 | 1.77 | 4.41 |
| *U. k. kudarensis* | 4 | 4.55 | 5.36 | 3.28 | | 3.29 | 1.58 | 1.95 | 0.93 | 2.14 | 5.38 |
| *U. s. spelaeus* | 5 | 1.65 | 2.57 | 0.39 | 3.24 | | 1.69 | 0.76 | 1.69 | 0.43 | 0.93 |
| *U. k. ingressus* | 6 | 2.08 | 3.06 | 0.67 | 4.02 | 0.25 | | 0.71 | 0.24 | 0.97 | 3.00 |
| *U. k. kanivetz* | 7 | 2.41 | 3.31 | 1.13 | 2.54 | 0.80 | 0.71 | | 0.83 | 0.27 | 1.68 |
| *U. s. eremus* | 8 | 2.22 | 3.13 | 0.93 | 2.83 | 0.57 | 0.43 | 0.25 | | 1.07 | 2.76 |
| *U. s. ladinicus* | 9 | 1.59 | 2.43 | 0.47 | 2.49 | 0.13 | 0.06 | 0.55 | 0.35 | | 1.27 |
| *U. arctos* | 10 | 0.86 | 0.20 | 2.24 | 6.79 | 2.90 | 3.72 | 3.89 | 3.66 | 2.64 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 1.77 | 6.17 | 5.88 | 1.76 | 3.90 | 1.46 | 3.15 | 1.19 | 1.42 |
| *U. rossicus* | 2 | 0.91 | | 6.47 | 6.04 | 2.71 | 4.71 | 2.44 | 4.06 | 2.19 | 2.68 |
| *U. k. praekudarensis* | 3 | 1.14 | 1.95 | | 1.54 | 1.72 | 1.43 | 2.00 | 1.24 | 2.27 | 3.61 |
| *U. k. kudarensis* | 4 | 4.40 | 4.81 | 3.20 | | 0.99 | 0.31 | 1.29 | 0.29 | 1.57 | 2.81 |
| *U. s. spelaeus* | 5 | 1.78 | 2.49 | 0.76 | 1.89 | | 0.72 | 0.22 | 0.63 | 0.43 | 0.74 |
| *U. k. ingressus* | 6 | 2.72 | 3.38 | 1.50 | 2.03 | 0.47 | | 1.00 | 0.04 | 1.25 | 2.03 |
| *U. k. kanivetz* | 7 | 1.07 | 1.91 | 0.11 | 3.50 | 0.88 | 1.69 | | 0.89 | 0.21 | 0.47 |
| *U. s. eremus* | 8 | 2.84 | 3.48 | 1.64 | 1.77 | 0.61 | 0.19 | 1.83 | | 1.12 | 1.71 |
| *U. s. ladinicus* | 9 | 0.95 | 1.76 | 0.15 | 3.20 | 0.88 | 1.59 | 0.05 | 1.72 | | 0.22 |
| *U. arctos* | 10 | 0.46 | 0.58 | 1.74 | 5.76 | 2.37 | 3.67 | 1.69 | 3.79 | 1.50 | |

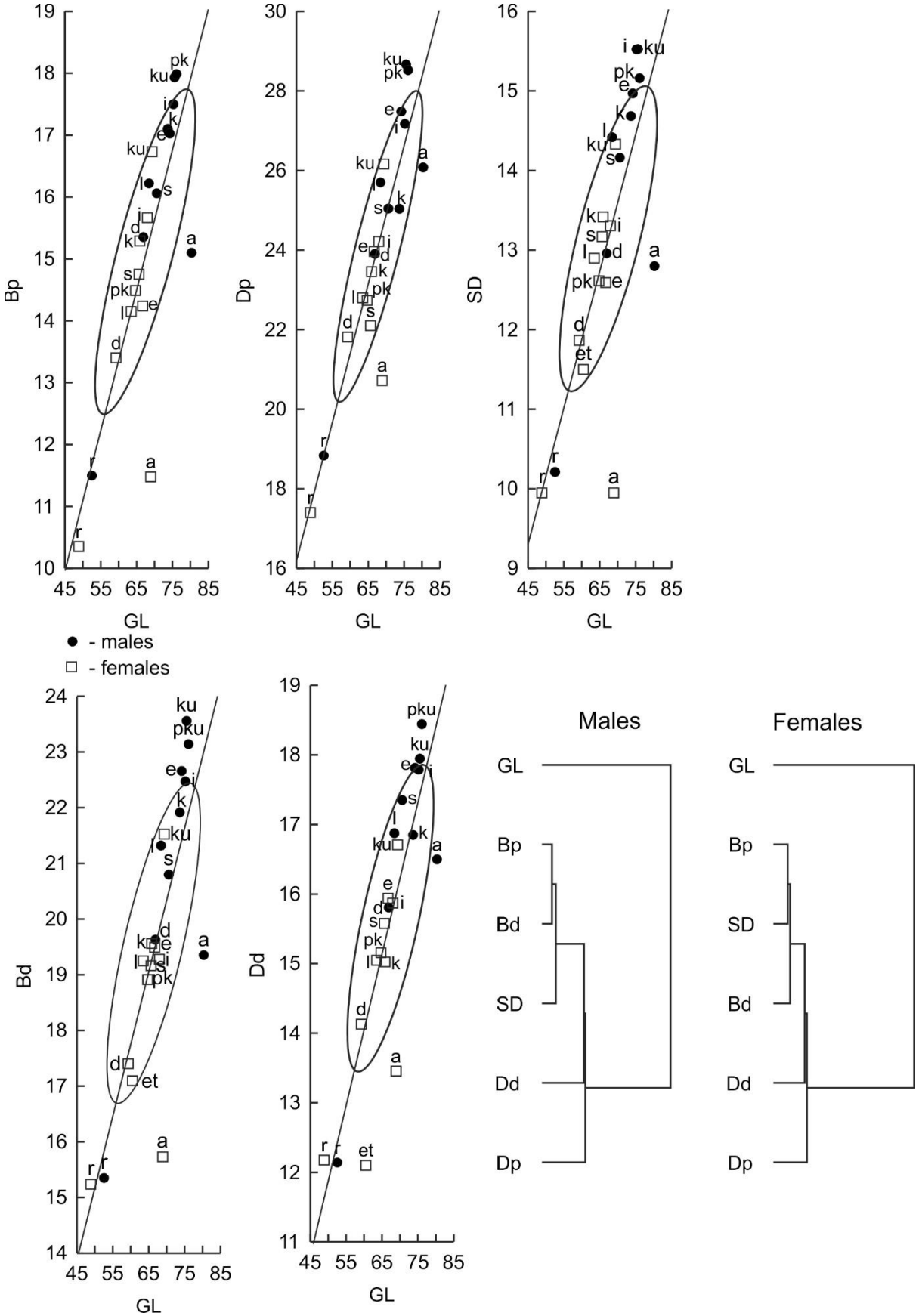


Fig. S6. The scatterplots of measures (GL – Dd) of mtt II and their UPMGA classification, and single linkage dendrograms of measurements based on the correlation metric. et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k,U – *U. k. kanivetz*, U, k,EE – *Ursus. kanivetz*, EE, e – *U. s. eremus*, l – *U. s. ladinicus.*.

Table S11. Statistical parameters of measures of mtt II among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | GL Std.Dev. | Bp - N | Bp | Bp Std.Dev. | Dp - N | Dp | Dp Std.Dev. | SD - N | SD | SD Std.Dev. | Bd - N | Bd | Bd Std.Dev. | Dd- N | Dd | Dd Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | f | 1 | 60.5 | | | | | | | | 1 | 11.5 | | 1 | 17.1 | | 1 | 12.1 | |
| *U. rossicus* | f | 5 | 48.9 | 0.85 | 4 | 10.4 | 0.47 | 3 | 17.4 | 1.22 | 4 | 10.0 | 0.37 | 5 | 15.2 | 0.21 | 4 | 12.2 | 0.10 |
| | m | 12 | 52.6 | 1.43 | 10 | 11.5 | 1.12 | 9 | 18.8 | 0.59 | 10 | 10.2 | 0.34 | 12 | 15.4 | 0.84 | 10 | 12.1 | 0.46 |
| *U. deningeri* | f | 6 | 59.3 | 2.49 | 6 | 13.4 | 1.40 | 6 | 21.8 | 1.34 | 6 | 11.9 | 1.77 | 6 | 17.4 | 1.28 | 6 | 14.1 | 0.93 |
| | m | 29 | 66.9 | 2.59 | 29 | 15.4 | 0.92 | 29 | 23.9 | 1.34 | 29 | 13.0 | 0.87 | 28 | 19.6 | 0.87 | 26 | 15.8 | 0.82 |
| *U. k. praekudarensis* | f | 7 | 64.7 | 1.40 | 8 | 14.5 | 1.73 | 6 | 22.7 | 2.23 | 7 | 12.6 | 0.43 | 7 | 18.9 | 1.09 | 7 | 15.2 | 0.78 |
| | m | 18 | 76.1 | 2.83 | 23 | 18.0 | 1.07 | 21 | 28.5 | 1.35 | 24 | 15.2 | 1.16 | 22 | 23.1 | 0.91 | 18 | 18.4 | 0.81 |
| *U. k. kudarensis* | f | 28 | 69.4 | 2.64 | 31 | 16.7 | 1.52 | 30 | 26.2 | 2.23 | 35 | 14.3 | 1.37 | 30 | 21.5 | 1.69 | 24 | 16.7 | 0.81 |
| | m | 50 | 75.6 | 2.19 | 52 | 17.9 | 1.41 | 48 | 28.7 | 1.86 | 52 | 15.5 | 1.28 | 52 | 23.6 | 1.67 | 43 | 17.9 | 0.87 |
| *U. s. spelaeus* | f | 10 | 65.7 | 1.60 | 10 | 14.8 | 0.58 | 8 | 22.1 | 0.88 | 10 | 13.2 | 0.70 | 10 | 19.2 | 0.75 | 5 | 15.6 | 0.36 |
| | m | 8 | 70.6 | 1.55 | 8 | 16.1 | 1.14 | 7 | 25.0 | 1.95 | 8 | 14.2 | 1.09 | 8 | 20.8 | 1.71 | 4 | 17.4 | 0.57 |
| *U. k. kanivetz*, EE | f | 25 | 68.0 | 2.54 | 6 | 15.7 | 0.68 | 6 | 24.2 | 0.72 | 26 | 13.3 | 0.83 | 25 | 19.3 | 0.91 | 14 | 15.9 | 0.85 |
| | m | 13 | 75.2 | 1.85 | 4 | 17.5 | 0.80 | 4 | 27.2 | 1.11 | 13 | 15.5 | 1.08 | 13 | 22.5 | 1.22 | 12 | 17.8 | 0.54 |
| *U. k. kanivetz*, U | f | 13 | 65.9 | 2.36 | 13 | 15.3 | 1.10 | 12 | 23.5 | 1.73 | 13 | 13.4 | 0.98 | 13 | 19.6 | 1.16 | 8 | 15.0 | 0.68 |
| | m | 6 | 73.7 | 3.89 | 6 | 17.1 | 0.63 | 5 | 25.0 | 0.67 | 6 | 14.7 | 0.95 | 6 | 21.9 | 0.50 | 4 | 16.9 | 1.63 |
| *U. s. eremus* | f | 13 | 66.7 | 2.13 | 13 | 14.2 | 0.82 | 13 | 24.0 | 1.23 | 13 | 12.6 | 0.84 | 13 | 19.5 | 0.91 | 13 | 15.9 | 0.80 |
| | m | 7 | 74.2 | 1.49 | 7 | 17.0 | 1.33 | 7 | 27.5 | 1.84 | 7 | 15.0 | 1.08 | 7 | 22.7 | 0.68 | 7 | 17.8 | 0.60 |
| *U. s. ladinicus* | f | 6 | 63.5 | 2.10 | 6 | 14.2 | 0.58 | 6 | 22.8 | 0.60 | 6 | 12.9 | 0.81 | 6 | 19.3 | 0.97 | 6 | 15.1 | 0.37 |
| | m | 5 | 68.5 | 2.19 | 5 | 16.2 | 0.56 | 5 | 25.7 | 1.45 | 5 | 14.4 | 1.04 | 5 | 21.3 | 1.52 | 4 | 16.9 | 2.06 |
| *U. arctos* | f | 10 | 68.9 | 5.84 | 10 | 11.5 | 1.65 | 9 | 20.7 | 2.10 | 10 | 10.0 | 0.97 | 10 | 15.7 | 1.19 | 9 | 13.5 | 1.11 |
| | m | 13 | 80.3 | 7.85 | 13 | 15.1 | 2.20 | 10 | 26.1 | 2.45 | 13 | 12.8 | 1.79 | 13 | 19.4 | 2.13 | 11 | 16.5 | 1.55 |

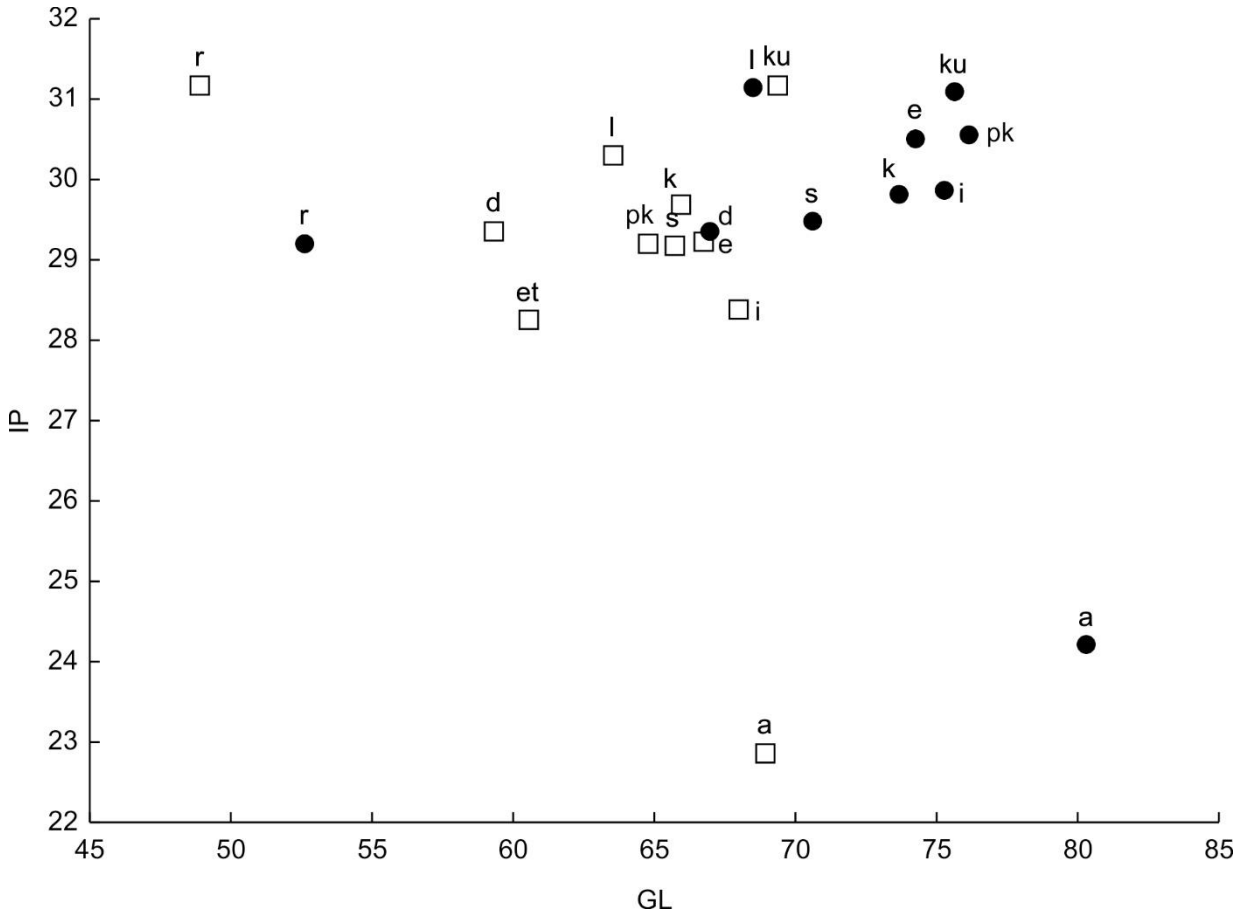


Fig. S7. The scatterplot of Index plumpness (ip) and GL of mtt II: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females.

## Multivariate analysis

Table S12. Description of the modeled morphological spaces for cave bears and brown bear mtt II. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.83 | 0.47 | 0.30 | 0.28 | 0.94 | 0.94 | -0.25 | 0.15 | 0.43 | 0.92 |
| Bp | 0.95 | -0.01 | -0.12 | 0.34 | 0.94 | 0.94 | -0.05 | 0.11 | 0.15 | 0.95 |
| Dp | 0.96 | 0.21 | 0.15 | 0.53 | 0.94 | 0.95 | -0.19 | -0.04 | 0.47 | 0.96 |
| SD | 0.93 | -0.18 | -0.31 | 0.45 | 0.95 | 0.93 | 0.16 | 0.40 | 0.34 | 0.96 |
| Bd | 0.96 | -0.04 | -0.09 | 0.60 | 0.96 | 0.96 | -0.00 | 0.15 | 0.39 | 0.94 |
| Dd | 0.95 | 0.22 | 0.05 | 0.49 | 0.92 | 0.95 | -0.27 | 0.15 | 0.29 | 0.94 |
| ip | 0.46 | -0.35 | -0.30 | 0.59 | | 0.43 | 0.44 | 0.13 | 0.14 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 61.2 | 40.9 | 31.4 | 39.0 | | 65.7 | 5.4 | 12.2 | 21.1 | |

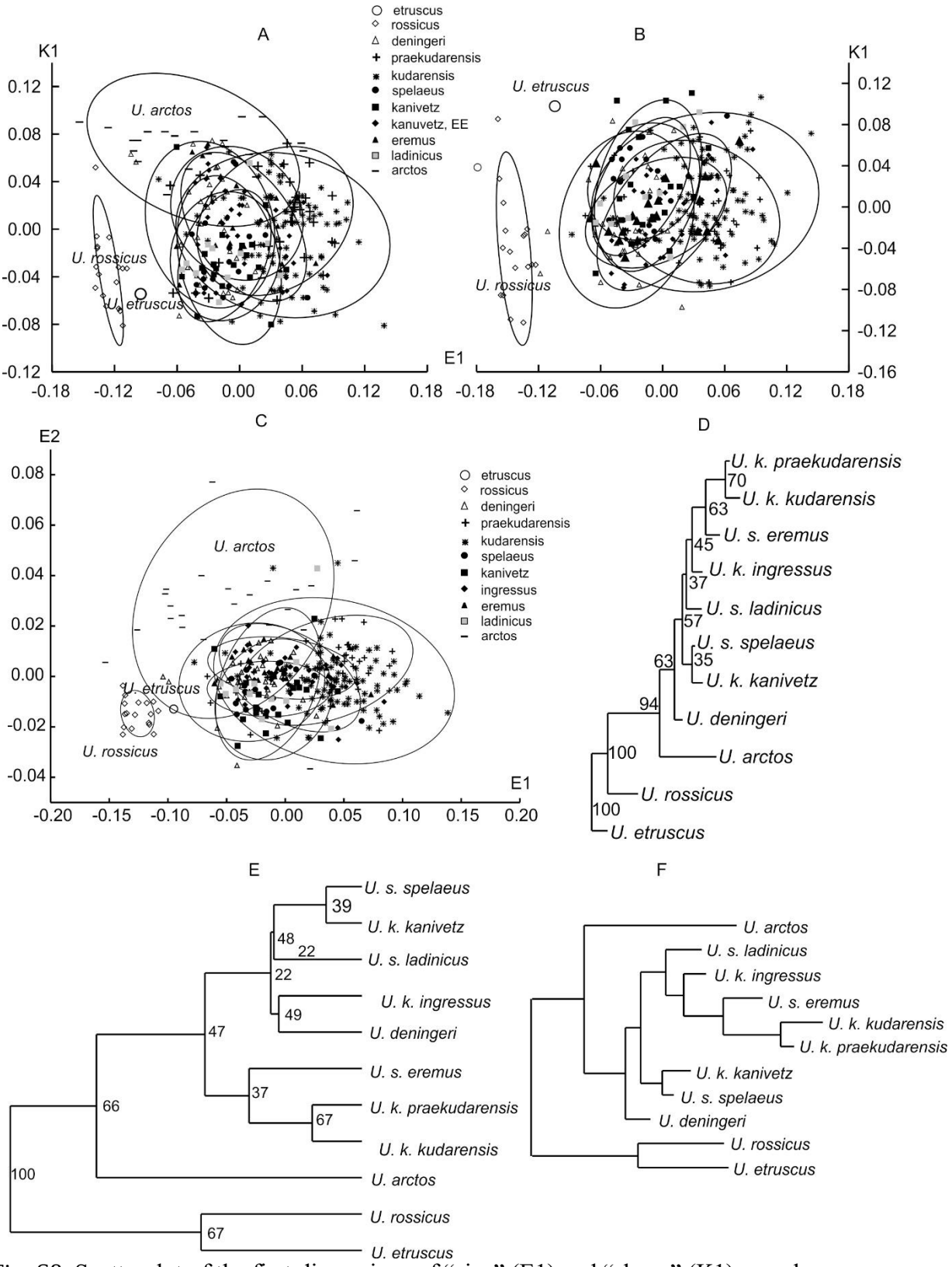


Fig. S8. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt II in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.92; F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S13. Description of the modeled morphological spaces for males of cave bears and brown bear mtt II. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.85 | 0.49 | 0.09 | 0.42 | 0.85 | 0.94 | 0.23 | 0.08 | 0.61 | 0.94 |
| Bp | 0.94 | 0.08 | -0.31 | 0.31 | 0.92 | 0.94 | 0.04 | 0.04 | 0.30 | 0.94 |
| Dp | 0.96 | 0.28 | -0.13 | 0.62 | 0.95 | 0.96 | 0.16 | -0.09 | 0.57 | 0.94 |
| SD | 0.93 | -0.14 | -0.54 | 0.36 | 0.95 | 0.94 | -0.19 | 0.35 | 0.44 | 0.96 |
| Bd | 0.95 | 0.03 | -0.30 | 0.54 | 0.93 | 0.96 | -0.04 | 0.06 | 0.52 | 0.94 |
| Dd | 0.94 | 0.20 | -0.22 | 0.43 | 0.89 | 0.95 | 0.10 | 0.07 | 0.43 | 0.91 |
| ip | 0.49 | -0.36 | -0.44 | 0.38 | | 0.46 | -0.48 | 0.15 | 0.07 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 83.2 | 38.9 | 29.7 | 35.0 | | 88.2 | 8.1 | 6.9 | 42.3 | |

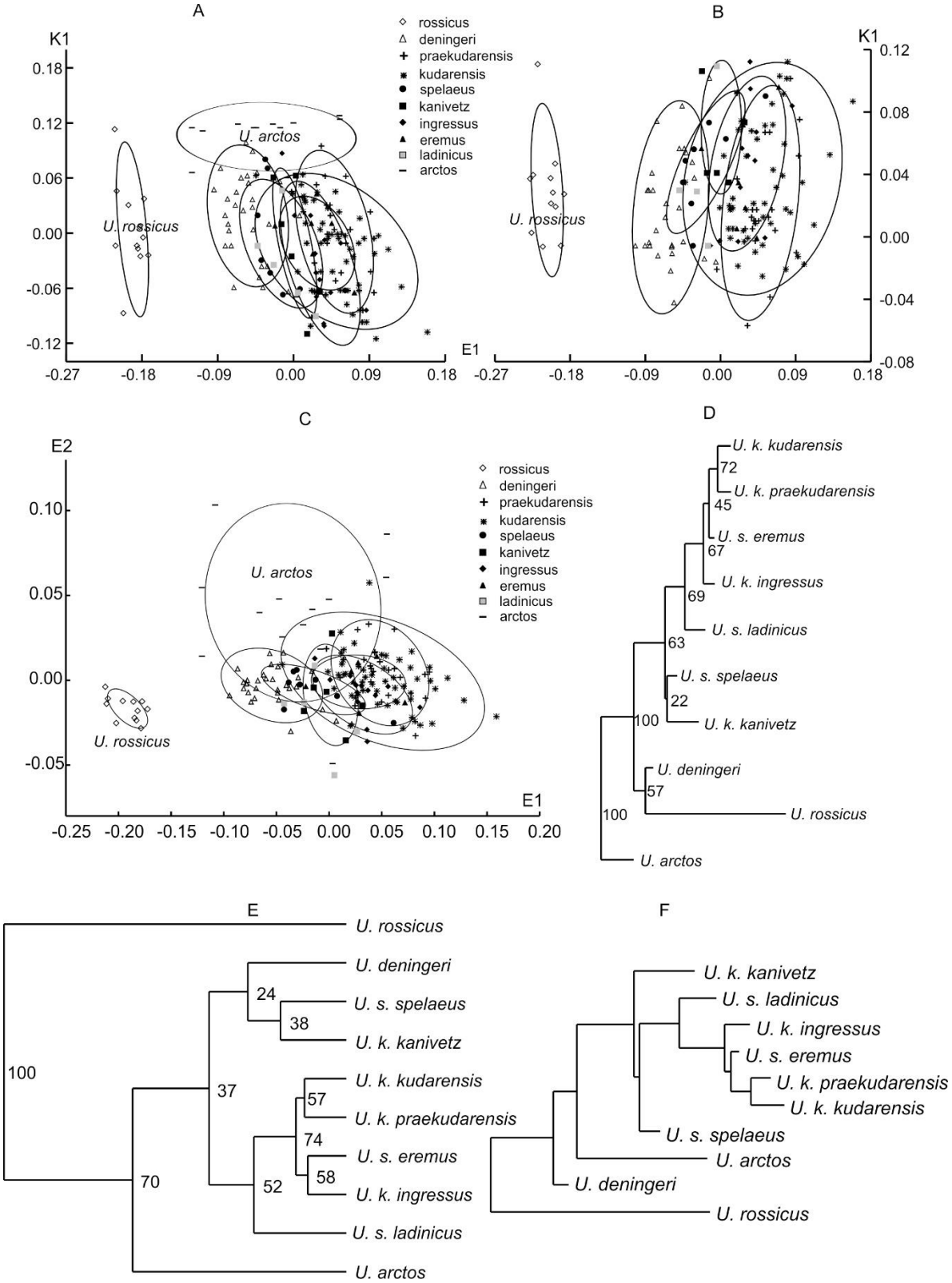


Fig. S9. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt II in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.90); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S14. Description of the modeled morphological spaces for females of cave bears and brown bear mtt II. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.67 | 0.60 | 0.15 | 0.31 | 0.83 | 0.91 | -0.10 | 0.05 | 0.31 | 0.82 |
| BP | 0.96 | -0.15 | -0.43 | 0.35 | 0.91 | 0.94 | 0.08 | 0.35 | 0.16 | 0.89 |
| BD | 0.92 | 0.10 | -0.20 | 0.31 | 0.89 | 0.91 | -0.14 | 0.07 | 0.07 | 0.89 |
| SD | 0.92 | -0.35 | -0.61 | 0.12 | 0.94 | 0.89 | 0.34 | 0.55 | 0.16 | 0.92 |
| DP | 0.96 | -0.18 | -0.50 | 0.40 | 0.94 | 0.95 | -0.04 | 0.37 | 0.18 | 0.90 |
| DD | 0.94 | 0.03 | -0.25 | 0.56 | 0.94 | 0.92 | -0.30 | 0.08 | 0.49 | 0.96 |
| ip | 0.33 | -0.41 | -0.69 | 0.27 | | 0.33 | 0.13 | 0.47 | -0.09 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | |
| | 73.3 | 57.1 | 46.0 | 15.6 | | 70.7 | 10.1 | 24.4 | 19.9 | |

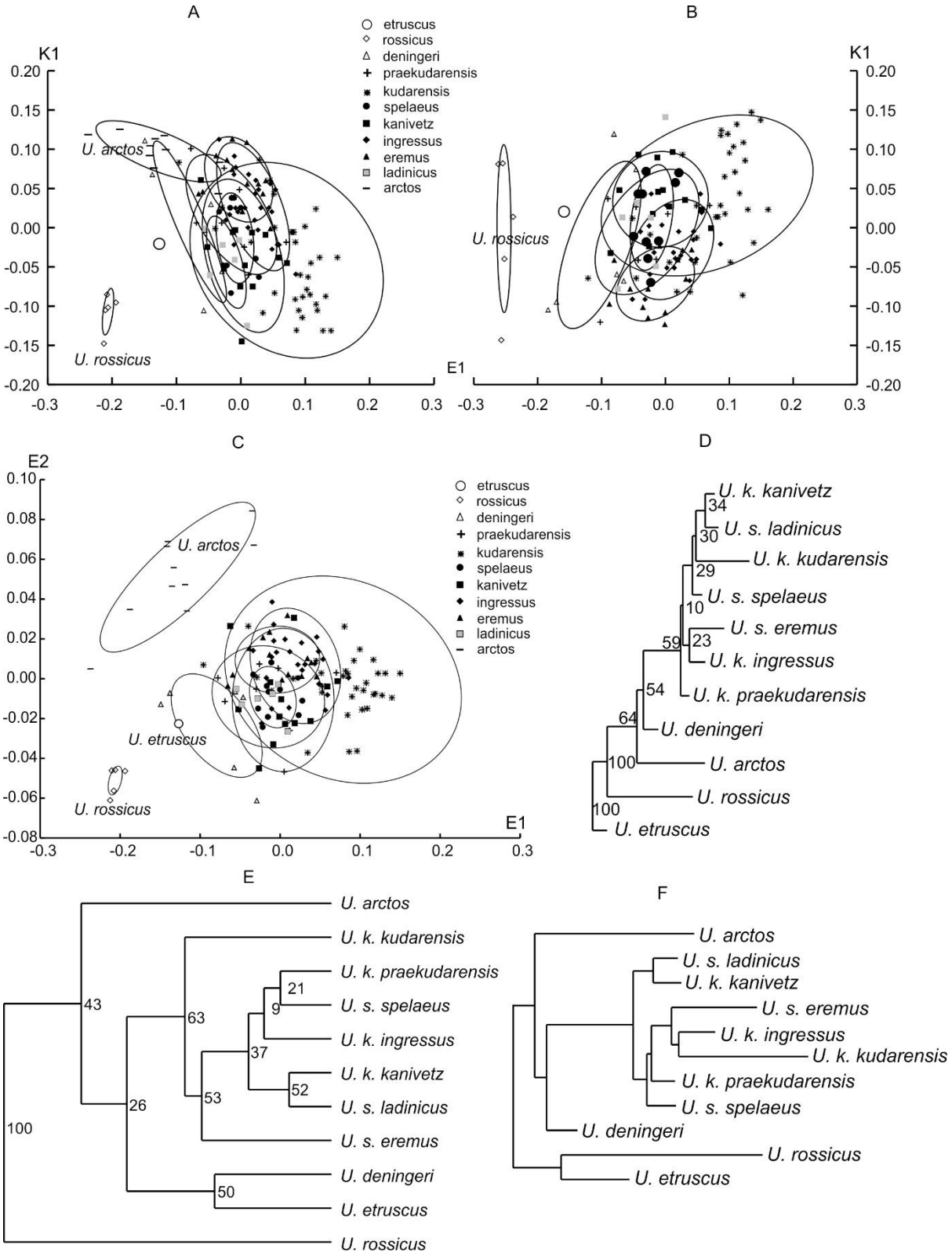


Fig. S10. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt II in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.86); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METATARSAL BONE III (MTT III)

## Males and females

Table S15. Sample numbers (N), means (M), and standard errors (m) of the variables of mtt III among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus* | 1 | 78.0 | | | | | 1 | 12.5 |
| *U. deningeri* | 38 | 75.4±0.92 | 38 | 18.7±0.34 | 37 | 28.6±0.45 | 38 | 14.1±0.25 |
| *U. k. praekudarensis* | 19 | 81.8±1.22 | 24 | 19.4±0.32 | 22 | 31.3±0.45 | 23 | 15.2±0.28 |
| *U. k. kudarensis* | 68 | 83.4±0.49 | 75 | 19.8±0.18 | 70 | 31.0±0.24 | 76 | 16.2±0.14 |
| *U. rossicus* | 17 | 58.8±0.58 | 17 | 14.2±0.32 | 17 | 23.3±0.43 | 17 | 11.5±0.14 |
| *U. s. spelaeus* | 18 | 78.8±1.19 | 18 | 19.1±0.44 | 15 | 29.6±0.72 | 18 | 15.9±0.33 |
| *U. k. kanivetz* | 22 | 78.4±1.04 | 24 | 18.9±0.46 | 21 | 29.8±0.69 | 24 | 15.7±0.28 |
| *U. s. eremus* | 20 | 78.1±1.29 | 20 | 19.3±0.46 | 20 | 30.0±0.54 | 20 | 14.8±0.33 |
| *U. s. ladinicus* | 14 | 71.7±0.91 | 14 | 17.6±0.51 | 14 | 27.9±0.57 | 14 | 13.8±0.36 |
| *U. k. ingressus* | 55 | 80.6±0.63 | 27 | 19.4±0.40 | 25 | 30.8±0.48 | 55 | 16.2±0.22 |
| *U. arctos* | 30 | 76.9±1.49 | 30 | 16.2±0.52 | 17 | 25.7±1.10 | 31 | 12.0±0.34 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus* | 1 | 18.2 | 1 | 14.7 |
| *U. deningeri* | 38 | 20.7±0.34 | 35 | 16.9±0.27 |
| *U. k. praekudarensis* | 20 | 22.5±0.43 | 17 | 18.1±0.33 |
| *U. k. kudarensis* | 69 | 23.2±0.20 | 63 | 18.5±0.13 |
| *U. rossicus* | 17 | 16.3±0.17 | 12 | 12.7±0.11 |
| *U. s. spelaeus* | 18 | 21.8±0.47 | 11 | 18.2±0.39 |
| *U. k. kanivetz* | 21 | 21.8±0.36 | 17 | 17.8±0.30 |
| *U. s. eremus* | 20 | 21.7±0.38 | 20 | 17.6±0.32 |
| *U. s. ladinicus* | 14 | 20.3±0.48 | 14 | 16.4±0.26 |
| *U. k. ingressus* | 55 | 22.4±0.27 | 41 | 18.0±0.24 |
| *U. arctos* | 31 | 17.5±0.45 | 19 | 15.9±0.55 |

### Sexual dimorphism

Table S16. Sexual size dimorphism (SSD and ASSD) of mtt III in the different forms of cave bears and brown bear ; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 80.5±0.77 | 20.3±0.43 | 30.9±0.55 | 15.1±0.35 | 22.2±0.50 | 18.0±0.37 | |
| Females | 71.2±0.70 | 17.5±0.31 | 26.8±0.35 | 13.3±0.24 | 19.5±0.27 | 16.0±0.23 | |
| *SSD* | 6.1±0.68 (*p*<0.001) | 7.4±1.41 (*p*<0.001) | 7.1±1.13 (*p*<0.001) | 6.4±1.49 (*p*<0.001) | 6.5±1.36 (*p*<0.001) | 5.9±1.30 (p<0.001) | 6.6 |
| *v, %* | 82.6 | 57.4 | 69.6 | 52.4 | 56.5 | 54.8 | |
| | | | | *U. rossicus* | | | |
| Males | 60.3±0.35 | 14.4±0.50 | 23.8±0.56 | 11.3±0.23 | 16.5±0.22 | 12.9±0.04 | |
| Females | 56.1±0.55 | 14.0±0.24 | 22.3±0.49 | 11.6±0.13 | 15.9±0.19 | 12.6±0.21 | |
| *SSD* | 3.6±0.56 | n.s. | (*p*=0.045) | n.s. | n.s. | n.s. | 1.7 |

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | (*p*<0.001) | | | | | | |
| *v, %* | 81.5 | - | - | - | - | - | |
| | | | *U. k. praekudarensis* | | | | |
| Males | 84.0±0.71 | 20.0±0.21 | 32.0±0.33 | 15.7±0.25 | 23.3±0.38 | 18.5±0.35 | |
| Females | 73.9±1.44 | 17.0±0.54 | 28.1±0.84 | 13.5±0.39 | 20.2±0.38 | 16.8±0.42 | |
| *SSD* | 6.4±1.02 | 8.1±1.56 | 6.5±1.51 | 7.4±1.60 | 7.3±1.24 | 4.8±1.55 | 6.8 |
| | (*p*<0.001) | (*p*<0.001) | (*p*=0.002) | (*p*<0.001) | (*p*<0.001) | (*p* =0.015) | |
| *v, %* | 84.0 | 81.1 | 73.2 | 55.0 | 82.0 | 44.6 | |
| | | | *U. k. kudarensis* | | | | |
| Males | 86.8±0.41 | 20.4±1.48 | 32.0±1.71 | 16.8±0.20 | 24.0±0.26 | 19.0±0.21 | |
| Females | 80.3±0.42 | 19.1±1.47 | 30.0±1.79 | 15.6±0.16 | 22.5±0.24 | 18.0±0.18 | |
| *SSD* | 3.9±0.35 | 3.2±0.86 | 3.2±0.68 | 3.5±0.80 | 3.3±0.76 | 2.7±0.59 | 2.9 |
| | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | |
| *v, %* | 78.3 | 18.1 | 33.5 | 33.8 | 38.4 | 36.6 | |
| | | | *U. s. spelaeus* | | | | |
| Males | 84.6±1.35 | 21.2±0.64 | 32.3±0.77 | 17.5±0.38 | 24.0±0.67 | 19.3±0.45 | |
| Females | 75.9±0.79 | 18.0±0.27 | 28.2±0.67 | 15.0±0.20 | 20.7±0.25 | 17.2±0.22 | |
| *SSD* | 5.4±0.97 | 8.3±1.78 | 6.9±1.68 | 7.6±1.32 | 7.5±1.61 | 5.6±1.37 | 6.9 |
| | (*p*<0.001) | (*p*<0.001) | (*p*=0.001) | (*p*<0.001) | (*p*<0.001) | (p=0.009) | |
| *v, %* | 78.5 | 68.2 | 71.6 | 89.8 | 83.6 | 90.7 | |
| | | | *U. s. ladinicus* | | | | |
| Males | 75.8±0.91 | 18.6±0.68 | 29.8±0.67 | 14.9±0.51 | 21.9±0.50 | 17.3±0.20 | |
| Females | 69.3±0.51 | 16.9±0.64 | 26.6±0.43 | 12.9±0.24 | 19.1±0.35 | 15.7±0.18 | |
| *SSD* | 4.0±0.72 | n.s. | 5.6±1.41 | 7.0±2.05 | 7.0±1.49 | 4.7±0.80 | 5.5 |
| | (*p*<0.001) | | (*p*=0.003) | (*p*=0.01) | (*p*=0.001) | (*p*=0.001) | |
| *v, %* | 81.7 | - | 69.0 | 62.0 | 76.8 | 83.9 | |
| | | | *U. s. eremus* | | | | |
| Males | 84.0±1.27 | 21.5±0.33 | 32.4±0.58 | 16.3±0.34 | 23.4±0.42 | 19.0±0.33 | |
| Females | 74.2±0.76 | 17.9±0.30 | 28.4±0.34 | 13.7±0.17 | 20.5±0.22 | 16.6±0.20 | |
| *SSD* | 6.2±0.94 | 9.1±1.15 | 6.6±1.11 | 8.6±1.27 | 6.4±1.09 | 6.7±1.10 | 7.3 |
| | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | |
| *v, %* | 83.6 | 86.2 | 80.2 | 85.0 | 80.8 | 81.2 | |
| | | | *U. k. ingressus* | | | | |
| Males | 85.2±0.55 | 21.6±0.47 | 33.5±0.50 | 17.8±0.22 | 24.3±0.28 | 19.3±0.21 | |
| Females | 77.2±0.41 | 18.1±0.22 | 29.3±0.26 | 15.0±0.15 | 21.6±0.16 | 16.8±0.18 | |
| *SSD* | 4.9±0.43 | 8.9±1.32 | 6.7±0.90 | 8.5±0.81 | 7.5±0.72 | 6.8±0.77 | 7.2 |
| | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | |
| *v, %* | 87.4 | 84.0 | 87.0 | 90.1 | 86.0 | 73.8 | |
| | | | *U. kanivetz* | | | | |
| Males | 84.1±0.67 | 20.9±0.58 | 32.1±1.04 | 16.6±0.44 | 23.2±0.59 | 19.2±0.34 | |
| Females | 75.1±0.54 | 17.1±0.33 | 28.0±0.50 | 15.0±0.24 | 21.0±0.27 | 17.1±0.15 | |
| *SSD* | 5.7±0.55 | 8.7±1.76 | 6.8±1.93 | 5.1±1.58 | 5.0±1.47 | 5.9±1.02 | 6.2 |
| | (*p*<0.001) | (*p*<0.001) | (*p*=0.009) | (*p*=0.003) | (*p*=0.006) | (*p*<0.001) | |
| *v, %* | 93.4 | 79.8 | 69.0 | 67.6 | 74.5 | 84.0 | |
| | | | *U. arctos* | | | | |
| Males | 86.3±3.22 | 19.3±1.33 | 29.3±1.72 | 13.8±0.64 | 20.4±0.71 | 17.7±0.62 | |
| Females | 73.5±0.93 | 15.1±0.27 | 23.2±0.75 | 11.2±0.27 | 16.4±0.32 | 14.2±0.45 | |
| *SSD* | 8.0±2.11 | 12.4±3.96 | 11.6±3.59 | 10.1±2.78 | 10.9±2.12 | 10.7±2.43 | 10.6 |
| | (*p*<0.001) | (*p*<0.001) | (*p*=0.002) | (*p*<0.001) | (*p*<0.001) | (*p*<0.001) | |

## Univariate analysis

Table S17. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtt III. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 2.21 | 1.98 | 5.10 | 1.88 | 3.21 | 1.84 | 1.75 | 1.21 | 2.68 |
| *U. rossicus* | 2 | 1.59 | | 3.90 | 6.83 | 3.45 | 5.13 | 3.55 | 3.46 | 0.55 | 4.32 |
| *U. k. praekudarensis* | 3 | 1.10 | 2.13 | | 2.54 | 0.36 | 0.92 | 0.17 | 0.08 | 2.65 | 0.98 |
| *U. k. kudarensis* | 4 | 7.51 | 6.35 | 3.17 | | 1.43 | 1.85 | 1.87 | 1.98 | 4.73 | 0.96 |
| *U. s. spelaeus* | 5 | 2.94 | 3.61 | 0.97 | 2.99 | | 0.29 | 0.19 | 0.27 | 2.54 | 0.48 |
| *U. k. ingressus* | 6 | 4.83 | 4.71 | 1.68 | 2.90 | 0.86 | | 0.57 | 0.67 | 3.49 | 0.31 |
| *U. k. kanivetz* | 7 | 2.35 | 3.17 | 0.50 | 3.97 | 0.65 | 1.70 | | 0.08 | 2.53 | 0.72 |
| *U. s. eremus* | 8 | 1.70 | 2.71 | 0.12 | 4.34 | 1.10 | 2.19 | 0.50 | | 2.45 | 0.80 |
| *U. s. ladinicus* | 9 | 0.90 | 0.67 | 1.62 | 6.24 | 3.16 | 4.38 | 2.68 | 2.17 | | 3.20 |
| *U. arctos* | 10 | 1.68 | 2.72 | 0.07 | 5.72 | 1.54 | 3.05 | 0.87 | 0.28 | 2.15 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 3.75 | 0.43 | 0.34 | 1.21 | 1.88 | 0.89 | 1.85 | 1.82 | 1.07 |
| *U. rossicus* | 2 | 2.83 | | 3.47 | 4.37 | 4.04 | 4.97 | 4.14 | 4.79 | 1.37 | 2.29 |
| *U. k. praekudarensis* | 3 | 0.55 | 1.80 | | 0.85 | 1.53 | 2.29 | 1.28 | 2.22 | 1.54 | 0.76 |
| *U. k. kudarensis* | 4 | 3.63 | 5.04 | 2.65 | | 1.08 | 1.83 | 0.72 | 1.78 | 2.19 | 1.44 |
| *U. s. spelaeus* | 5 | 0.96 | 3.30 | 1.17 | 1.93 | | 0.34 | 0.42 | 0.40 | 2.49 | 1.92 |
| *U. k. ingressus* | 6 | 1.38 | 3.66 | 1.42 | 1.84 | 0.27 | | 0.88 | 0.09 | 3.13 | 2.55 |
| *U. k. kanivetz* | 7 | 0.02 | 2.72 | 0.54 | 3.13 | 0.86 | 1.23 | | 0.92 | 2.36 | 1.72 |
| *U. s. eremus* | 8 | 0.81 | 3.20 | 1.07 | 2.09 | 0.13 | 0.42 | 0.73 | | 3.07 | 2.50 |
| *U. s. ladinicus* | 9 | 0.41 | 2.18 | 0.18 | 2.97 | 1.13 | 1.45 | 0.40 | 1.01 | | 0.75 |
| *U. arctos* | 10 | 3.56 | 0.65 | 1.64 | 7.74 | 4.00 | 4.76 | 3.20 | 3.85 | 2.22 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 3.04 | 1.31 | 1.39 | 1.25 | 2.71 | 1.71 | 1.46 | 1.09 | 0.66 |
| *U. rossicus* | 2 | 1.85 | | 4.15 | 4.42 | 3.43 | 5.03 | 4.18 | 3.90 | 1.47 | 1.96 |
| *U. k. praekudarensis* | 3 | 0.96 | 2.15 | | 0.10 | 0.38 | 1.67 | 0.65 | 0.44 | 2.06 | 1.68 |
| *U. k. kudarensis* | 4 | 5.49 | 5.09 | 1.87 | | 0.46 | 1.90 | 0.79 | 0.55 | 2.13 | 1.74 |
| *U. s. spelaeus* | 5 | 1.86 | 2.99 | 0.32 | 2.22 | | 0.88 | 0.14 | 0.01 | 1.92 | 1.60 |
| *U. k. ingressus* | 6 | 3.55 | 4.10 | 1.17 | 1.10 | 1.15 | | 0.88 | 1.02 | 3.13 | 2.84 |
| *U. k. kanivetz* | 7 | 1.46 | 2.73 | 0.01 | 2.94 | 0.43 | 1.70 | | 0.16 | 2.34 | 2.01 |
| *U. s. eremus* | 8 | 1.96 | 3.06 | 0.32 | 2.40 | 0.01 | 1.23 | 0.44 | | 2.14 | 1.81 |
| *U. s. ladinicus* | 9 | 0.36 | 1.36 | 1.10 | 4.24 | 1.82 | 3.07 | 1.48 | 1.88 | | 0.40 |
| *U. arctos* | 10 | 1.97 | 0.30 | 2.16 | 6.34 | 3.29 | 4.80 | 3.00 | 3.42 | 1.28 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 2.22 | 0.53 | 3.24 | 3.19 | 5.13 | 2.26 | 1.59 | 0.39 | 0.98 |
| *U. rossicus* | 2 | 1.66 | | 2.64 | 4.72 | 4.51 | 6.10 | 3.85 | 3.24 | 1.46 | 1.17 |
| *U. k. praekudarensis* | 3 | 0.13 | 1.37 | | 2.68 | 2.83 | 4.64 | 1.83 | 1.17 | 0.78 | 1.43 |
| *U. k. kudarensis* | 4 | 5.53 | 5.17 | 3.03 | | 1.29 | 2.63 | 0.12 | 0.68 | 2.58 | 3.64 |
| *U. s. spelaeus* | 5 | 3.10 | 3.78 | 1.99 | 1.16 | | 0.27 | 1.19 | 1.55 | 2.94 | 3.64 |
| *U. k. ingressus* | 6 | 3.87 | 4.17 | 2.13 | 1.74 | 0.10 | | 1.95 | 2.34 | 3.98 | 5.20 |
| *U. k. kanivetz* | 7 | 3.16 | 3.81 | 1.97 | 1.33 | 0.08 | 0.01 | | 0.47 | 2.11 | 2.84 |
| *U. s. eremus* | 8 | 0.42 | 1.84 | 0.17 | 4.08 | 2.37 | 2.76 | 2.38 | | 1.60 | 2.23 |
| *U. s. ladinicus* | 9 | 0.57 | 0.98 | 0.53 | 4.48 | 2.98 | 3.35 | 2.99 | 0.85 | | 0.42 |
| *U. arctos* | 10 | 2.50 | 0.02 | 1.66 | 8.46 | 5.25 | 6.68 | 5.41 | 2.55 | 1.27 | |
| | | | | | Bd | | | | | | |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. deningeri* | 1 | | 3.23 | 1.11 | 2.57 | 1.48 | 3.13 | 1.13 | 1.02 | 0.75 | 1.73 |
| *U. rossicus* | 2 | 2.08 | | 4.14 | 5.79 | 3.85 | 6.14 | 3.73 | 3.63 | 1.76 | 1.19 |
| *U. k. praekudarensis* | 3 | 0.62 | 2.09 | | 1.19 | 0.64 | 1.83 | 0.20 | 0.10 | 1.55 | 2.63 |
| *U. k. kudarensis* | 4 | 5.91 | 5.87 | 2.76 | | 0.14 | 0.86 | 0.72 | 0.83 | 2.53 | 3.94 |
| *U. s. spelaeus* | 5 | 1.73 | 3.18 | 0.60 | 2.99 | | 0.65 | 0.41 | 0.49 | 1.83 | 2.69 |
| *U. k. ingressus* | 6 | 3.02 | 4.07 | 1.13 | 3.19 | 0.65 | | 1.26 | 1.37 | 2.96 | 4.36 |
| *U. k. kanivetz* | 7 | 2.42 | 3.68 | 1.04 | 2.38 | 0.56 | 0.01 | | 0.09 | 1.55 | 2.47 |
| *U. s. eremus* | 8 | 1.41 | 2.94 | 0.38 | 3.35 | 0.29 | 1.00 | 0.86 | | 1.47 | 2.37 |
| *U. s. ladinicus* | 9 | 0.63 | 1.29 | 1.00 | 4.83 | 1.95 | 2.81 | 2.48 | 1.69 | | 0.68 |
| *U. arctos* | 10 | 2.73 | 0.28 | 2.30 | 9.07 | 4.07 | 6.07 | 4.81 | 3.74 | 1.38 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 2.65 | 0.58 | 2.26 | 1.94 | 2.74 | 1.81 | 1.51 | 1.48 | 0.40 |
| *U. rossicus* | 2 | 2.22 | | 3.01 | 4.40 | 3.74 | 4.70 | 3.70 | 3.56 | 0.97 | 2.09 |
| *U. k. praekudarensis* | 3 | 1.13 | 2.57 | | 1.46 | 1.48 | 1.99 | 1.32 | 0.97 | 1.87 | 0.88 |
| *U. k. kudarensis* | 4 | 5.52 | 5.93 | 1.83 | | 0.61 | 0.79 | 0.37 | 0.12 | 3.15 | 2.28 |
| *U. s. spelaeus* | 5 | 2.17 | 3.56 | 0.62 | 1.29 | | 0.13 | 0.21 | 0.60 | 2.81 | 2.08 |
| *U. k. ingressus* | 6 | 2.07 | 3.66 | 0.05 | 3.43 | 0.81 | | 0.14 | 0.66 | 3.50 | 2.71 |
| *U. k. kanivetz* | 7 | 2.14 | 3.65 | 0.33 | 2.24 | 0.41 | 0.45 | | 0.39 | 2.73 | 1.96 |
| *U. s. eremus* | 8 | 1.09 | 2.88 | 0.38 | 3.53 | 1.23 | 0.68 | 0.98 | | 2.52 | 1.69 |
| *U. s. ladinicus* | 9 | 0.75 | 1.27 | 1.52 | 4.62 | 2.43 | 2.26 | 2.37 | 1.54 | | 1.03 |
| *U. arctos* | 10 | 1.75 | 0.69 | 2.21 | 6.31 | 3.30 | 3.49 | 3.43 | 2.54 | 0.72 | |

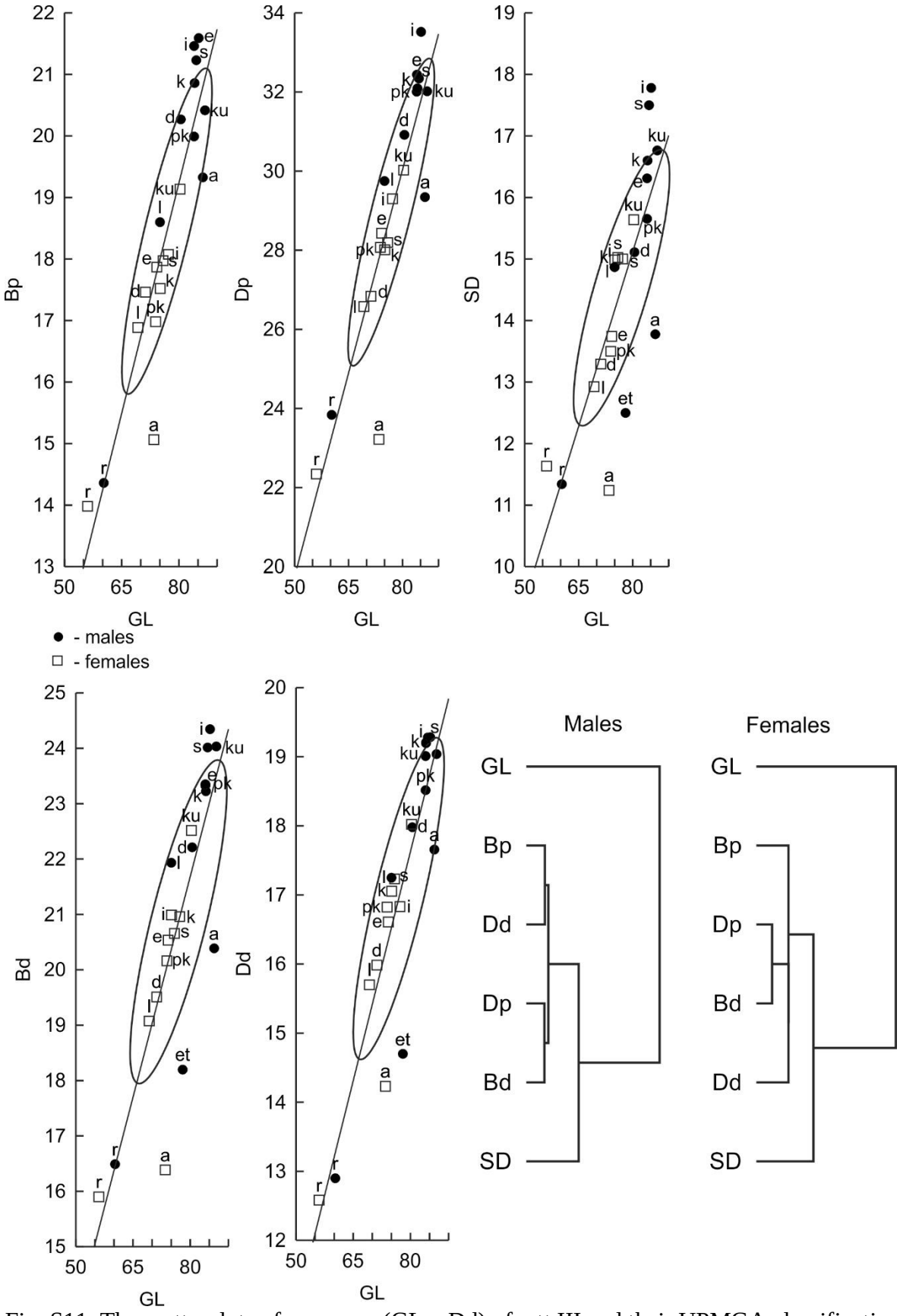


Fig. S11. The scatterplots of measures (GL – Dd) of mtt III and their UPMGA classification, and single linkage dendrograms of measurements based on the correlation metric. et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, U, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*..

Table S18. Statistical parameters of measures of mtt III among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | GL Std.De | Bp - N | Bp | Bp Std.De | Dp - N | Dp | Dp Std.De | SD - N | SD | SD Std.De | Bd - N | Bd | Bd Std.De | Dd- N | Dd | Dd Std.De |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | m | 1 | 78.0 | | | | | | | | 1 | 12.5 | | 1 | 18.2 | | 1 | 14.7 | |
| *U. rossicus* | f | 6 | 56.1 | 0.55 | 5 | 14.0 | 0.24 | 5 | 22.3 | 0.49 | 6 | 11.6 | 0.13 | 6 | 15.9 | 0.19 | 6 | 12.6 | 0.21 |
| | m | 11 | 60.3 | 0.35 | 8 | 14.4 | 0.50 | 8 | 23.8 | 0.56 | 7 | 11.3 | 0.23 | 11 | 16.5 | 0.22 | 6 | 12.9 | 0.04 |
| *U. deningeri* | f | 21 | 71.2 | 0.70 | 21 | 17.5 | 0.31 | 21 | 26.8 | 0.35 | 21 | 13.3 | 0.24 | 21 | 19.5 | 0.27 | 19 | 16.0 | 0.23 |
| | m | 17 | 80.5 | 0.77 | 17 | 20.3 | 0.43 | 16 | 30.9 | 0.55 | 17 | 15.1 | 0.35 | 17 | 22.2 | 0.50 | 16 | 18.0 | 0.37 |
| *U. k. praekudarensis* | f | 5 | 73.9 | 1.44 | 5 | 17.0 | 0.54 | 4 | 28.1 | 0.84 | 5 | 13.5 | 0.39 | 5 | 20.2 | 0.38 | 4 | 16.8 | 0.42 |
| | m | 14 | 84.0 | 0.71 | 19 | 20.0 | 0.21 | 18 | 32.0 | 0.33 | 18 | 15.7 | 0.25 | 15 | 23.3 | 0.38 | 13 | 18.5 | 0.35 |
| *U. k. kudarensis* | f | 36 | 80.3 | 0.42 | 38 | 19.1 | 0.24 | 36 | 30.0 | 0.30 | 38 | 15.6 | 0.16 | 36 | 22.5 | 0.24 | 33 | 18.0 | 0.18 |
| | m | 32 | 86.8 | 0.41 | 37 | 20.4 | 0.24 | 34 | 32.0 | 0.29 | 38 | 16.8 | 0.20 | 33 | 24.0 | 0.26 | 30 | 19.0 | 0.13 |
| *U. s. spelaeus* | f | 12 | 75.9 | 0.79 | 12 | 18.0 | 0.27 | 10 | 28.2 | 0.67 | 12 | 15.0 | 0.20 | 12 | 20.7 | 0.25 | 6 | 17.2 | 0.22 |
| | m | 6 | 84.6 | 1.35 | 6 | 21.2 | 0.64 | 5 | 32.3 | 0.77 | 6 | 17.5 | 0.38 | 6 | 24.0 | 0.67 | 5 | 19.3 | 0.45 |
| *U. k. ingressus* | f | 32 | 77.2 | 0.41 | 17 | 18.1 | 0.22 | 16 | 29.3 | 0.26 | 32 | 15.0 | 0.15 | 32 | 21.0 | 0.16 | 22 | 16.8 | 0.18 |
| | m | 23 | 85.2 | 0.55 | 10 | 21.6 | 0.47 | 9 | 33.5 | 0.50 | 23 | 17.8 | 0.22 | 23 | 24.3 | 0.28 | 19 | 19.3 | 0.21 |
| *U. k. kanivetz* | f | 14 | 75.1 | 0.54 | 14 | 17.5 | 0.33 | 12 | 28.0 | 0.50 | 14 | 15.0 | 0.24 | 13 | 21.0 | 0.27 | 11 | 17.1 | 0.15 |
| | m | 8 | 84.1 | 0.67 | 10 | 20.9 | 0.58 | 9 | 32.1 | 1.04 | 10 | 16.6 | 0.44 | 8 | 23.2 | 0.59 | 6 | 19.2 | 0.34 |
| *U. s. eremus* | f | 12 | 74.2 | 0.76 | 12 | 17.9 | 0.30 | 12 | 28.4 | 0.34 | 12 | 13.7 | 0.17 | 12 | 20.5 | 0.22 | 12 | 16.6 | 0.20 |
| | m | 8 | 84.0 | 1.27 | 8 | 21.5 | 0.33 | 8 | 32.4 | 0.58 | 8 | 16.3 | 0.34 | 8 | 23.4 | 0.42 | 8 | 19.0 | 0.33 |
| *U. s. ladinicus* | f | 8 | 69.3 | 0.51 | 8 | 16.9 | 0.64 | 8 | 26.6 | 0.43 | 8 | 12.9 | 0.24 | 8 | 19.1 | 0.35 | 7 | 15.7 | 0.18 |
| | m | 6 | 75.0 | 0.91 | 6 | 18.6 | 0.68 | 6 | 29.8 | 0.67 | 6 | 14.9 | 0.51 | 6 | 21.9 | 0.50 | 6 | 17.3 | 0.20 |
| *U. arctos* | f | 22 | 73.5 | 0.93 | 22 | 15.1 | 0.27 | 10 | 23.2 | 0.75 | 22 | 11.2 | 0.27 | 22 | 16.4 | 0.32 | 10 | 14.2 | 0.45 |
| | m | 8 | 86.3 | 3.22 | 8 | 19.3 | 1.33 | 7 | 29.3 | 1.72 | 9 | 13.8 | 0.64 | 9 | 20.4 | 0.71 | 9 | 17.7 | 0.62 |

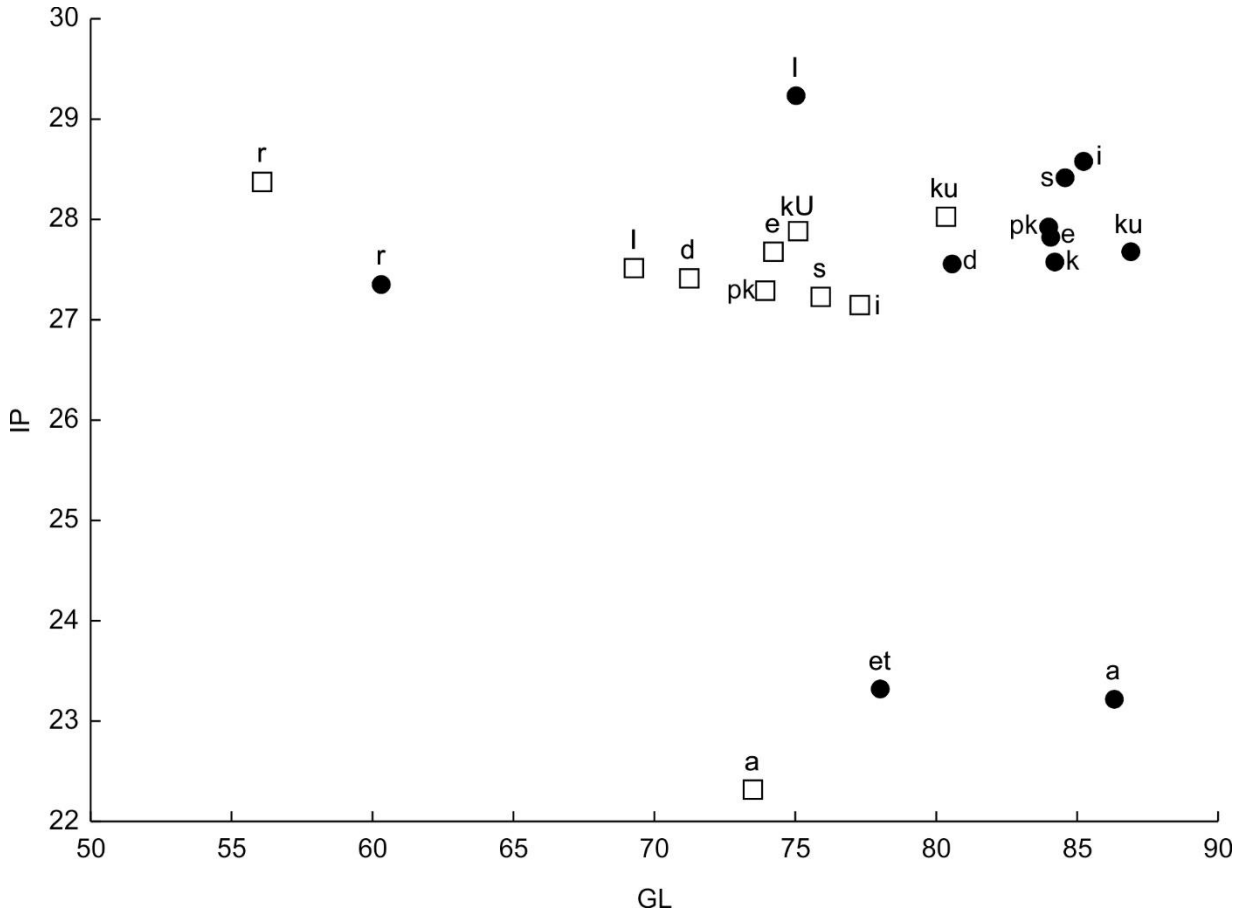


Fig. S12. The scatterplot of Index plumpness (ip) and GL of mtt III: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, U, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females.

## Multivariate analysis

Table S19. Description of the modeled morphological spaces for males of cave bears and brown bear mtt III. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E | K1 | K2 | | E | K1 | K2 | |
| GL | 0.89 | 0.35 | 0.17 | 0.91 | 0.94 | 0.21 | 0.16 | 0.91 |
| Bp | 0.91 | 0.24 | -0.31 | 0.93 | 0.90 | -0.31 | 0.21 | 0.95 |
| Dp | 0.94 | 0.01 | -0.15 | 0.90 | 0.92 | -0.01 | -0.16 | 0.94 |
| SD | 0.91 | -0.20 | 0.09 | 0.91 | 0.90 | 0.22 | 0.01 | 0.84 |
| Bd | 0.95 | -0.10 | -0.02 | 0.94 | 0.95 | 0.15 | 0.13 | 0.91 |
| Dd | 0.96 | 0.14 | 0.02 | 0.92 | 0.95 | 0.10 | 0.22 | 0.91 |
| ip | 0.30 | -0.54 | -0.30 | | 0.29 | -0.07 | -0.06 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | |
| | 55.2 | 38.7 | 17.1 | | 56.6 | 11.0 | 16.5 | |

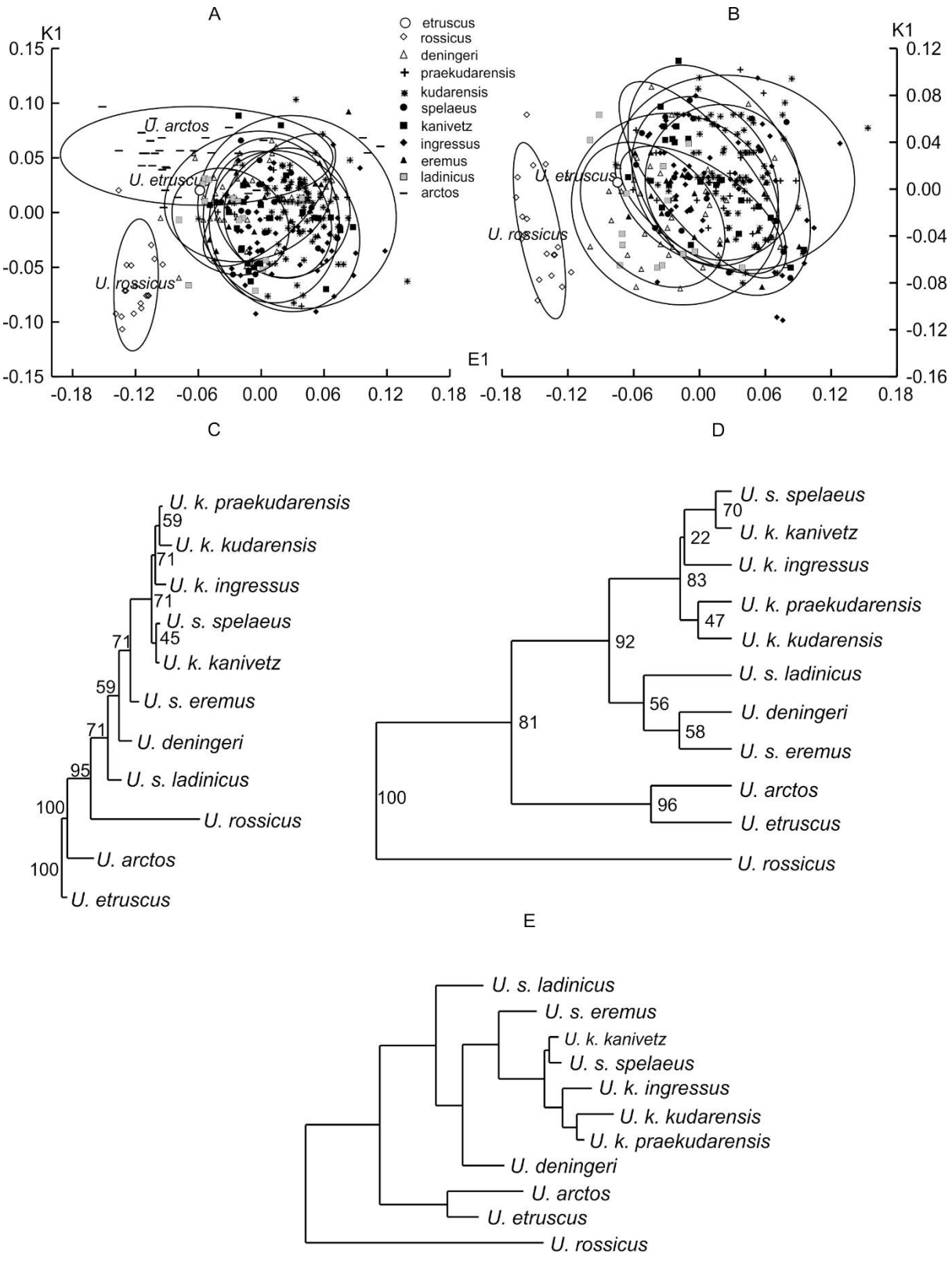


Fig. S13. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt III in males and females: A – models with *U. arctos*; B – model without *U. arctos*; C – NJ tree; D – UGMA dendrogram (cophenetic correlation – 0.96); E – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S20. Description of the modeled morphological spaces for males of cave bears and brown bear mtt III. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E, K1–K3); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E | K1 | K2 | | E | K1 | K2 | |
| GL | 0.89 | 0.42 | 0.29 | 0.90 | 0.93 | 0.41 | 0.46 | 0.91 |
| Bp | 0.88 | -0.18 | 0.32 | 0.94 | 0.87 | -0.18 | 0.50 | 0.94 |
| Dp | 0.89 | 0.04 | -0.09 | 0.85 | 0.88 | 0.14 | 0.07 | 0.88 |
| SD | 0.87 | 0.23 | -0.19 | 0.84 | 0.87 | 0.27 | 0.19 | 0.79 |
| Bd | 0.91 | 0.25 | -0.04 | 0.86 | 0.93 | 0.32 | 0.35 | 0.87 |
| Dd | 0.94 | 0.35 | 0.20 | 0.90 | 0.94 | 0.34 | 0.47 | 0.91 |
| ip | 0.33 | -0.18 | -0.37 | | 0.31 | -0.03 | -0.11 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | |
| | 78.7 | 30.2 | 30.9 | | 87.7 | 27.7 | 22.7 | |

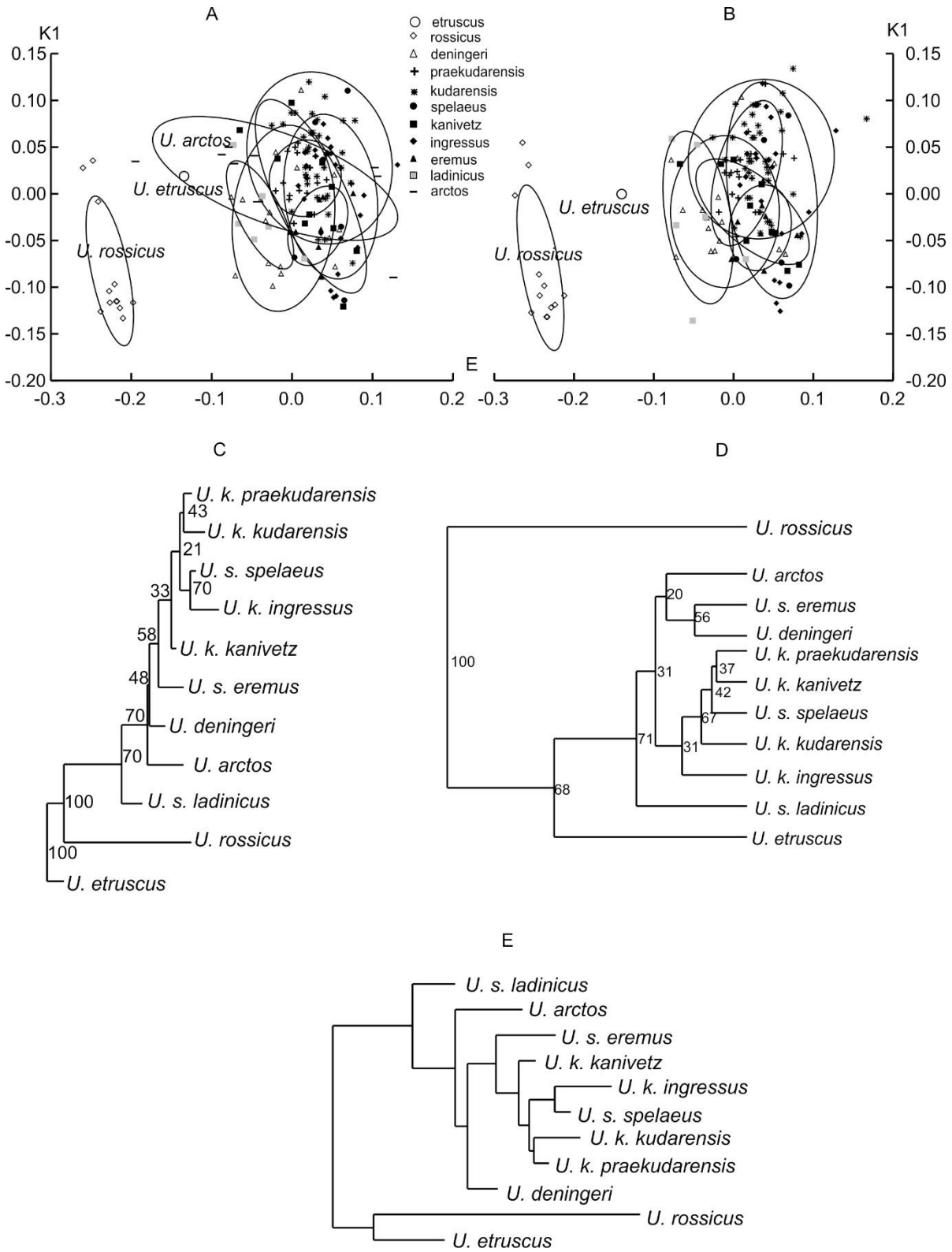


Fig. S14. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt III in males: A – models with *U. arctos*; B – model without *U. arctos*; C – NJ tree; D – UGMA dendrogram (cophenetic correlation – 0.95); E – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S21. Description of the modeled morphological spaces for females of cave bears and brown bear mtt III. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E, E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.82 | 0.18 | 0.36 | 0.76 | 0.92 | 0.06 | 0.12 | 0.48 | 0.89 |
| Bp | 0.88 | 0.15 | -0.02 | 0.81 | 0.83 | 0.43 | -0.12 | -0.03 | 0.88 |
| Dp | 0.94 | 0.09 | -0.14 | 0.93 | 0.91 | 0.19 | -0.02 | 0.27 | 0.86 |
| SD | 0.91 | -0.37 | 0.02 | 0.95 | 0.91 | -0.34 | 0.54 | 0.25 | 0.97 |
| Bd | 0.96 | -0.19 | -0.03 | 0.96 | 0.95 | -0.07 | 0.31 | 0.35 | 0.90 |
| Dd | 0.95 | 0.09 | 0.13 | 0.91 | 0.93 | 0.18 | 0.06 | 0.26 | 0.88 |
| ip | 0.19 | -0.42 | -0.39 | | 0.21 | -0.24 | 0.35 | -0.09 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | |
| | 81.2 | 17.9 | 18.6 | | 76.4 | 11.8 | 21.4 | 28.7 | |

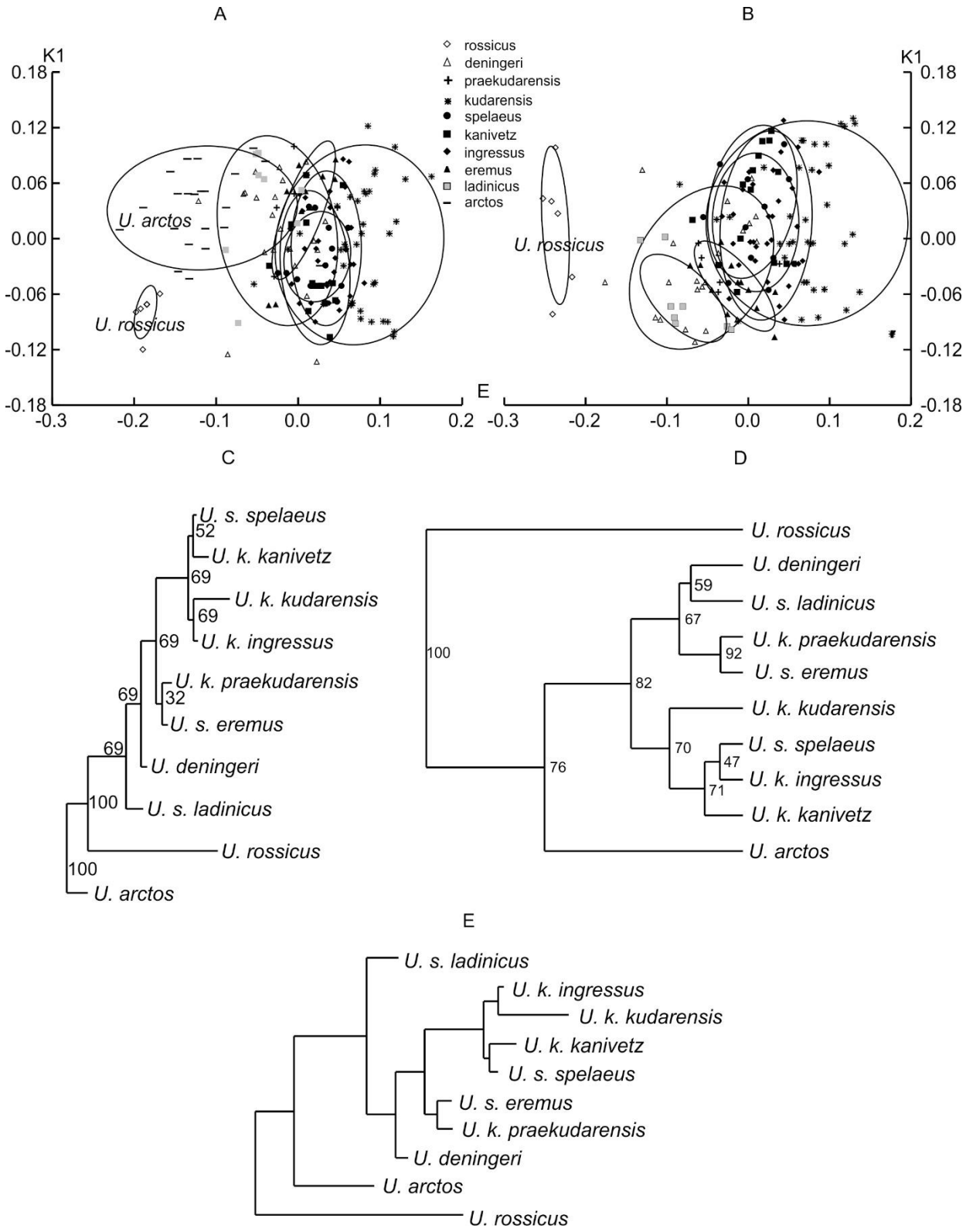


Fig. S15. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt III in females: A – models with *U. arctos*; B – model without *U. arctos*; C – NJ tree; D – UGMA dendrogram (cophenetic correlation – 0.95); E – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E, E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METATARSAL BONE IV (MTT IV)

## Males and females

Table S22. Sample numbers (N), means (M), and standard errors (m) of the variables of mtt IV among the different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus* | 2 | 78.5 | | | | | 2 | 12.05 |
| *U. deningeri* | 37 | 82.0±0.80 | 37 | 20.6±0.26 | 36 | 27.7±0.43 | 38 | 14.9±0.23 |
| *U. k. praekudarensis* | 16 | 89.9±1.84 | 19 | 24.0±0.66 | 17 | 30.1±0.79 | 19 | 16.7±0.39 |
| *U. k. kudarensis* | 80 | 93.4±0.58 | 96 | 24.2±0.27 | 90 | 31.7±0.28 | 96 | 17.7±0.15 |
| *U. rossicus* | 28 | 64.5±0.57 | 20 | 16.9±0.31 | 20 | 22.4±0.33 | 20 | 12.2±0.16 |
| *U. s. spelaeus* | 18 | 86.6±1.33 | 18 | 21.5±0.46 | 13 | 31.7±0.81 | 18 | 16.0±0.30 |
| *U. k. kanivetz* | 20 | 82.5±1.53 | 22 | 20.2±0.45 | 19 | 29.3±0.75 | 22 | 15.9±0.32 |
| *U. s. eremus* | 20 | 86.6±1.11 | 20 | 20.1±0.26 | 20 | 32.4±0.73 | 20 | 15.7±0.36 |
| *U. s. ladinicus* | 12 | 82.4±1.89 | 12 | 19.3±0.50 | 12 | 30.5±1.02 | 12 | 14.1±0.48 |
| *U. k. ingressus* | 53 | 87.3±0.81 | 24 | 22.5±0.38 | 23 | 31.8±0.53 | 55 | 16.3±0.23 |
| *U. arctos* | 23 | 84.3±1.75 | 23 | 18.8±0.57 | 18 | 25.9±0.86 | 23 | 12.5±0.37 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus* | 2 | 18.1 | 2 | 13.8 |
| *U. deningeri* | 36 | 22.5±0.32 | 36 | 17.7±0.22 |
| *U. k. praekudarensis* | 15 | 24.7±0.66 | 13 | 19.4±0.63 |
| *U. k. kudarensis* | 79 | 26.3±0.22 | 72 | 20.0±0.13 |
| *U. rossicus* | 28 | 17.7±0.17 | 18 | 13.6±0.16 |
| *U. s. spelaeus* | 17 | 23.5±0.50 | 5 | 19.1±0.78 |
| *U. k. kanivetz* | 19 | 23.0±0.51 | 15 | 17.5±0.45 |
| *U. s. eremus* | 20 | 23.8±0.38 | 20 | 19.1±0.27 |
| *U. s. ladinicus* | 12 | 22.3±0.66 | 9 | 17.8±0.45 |
| *U. k. ingressus* | 53 | 23.7±0.29 | 37 | 18.7±0.21 |
| *U. arctos* | 23 | 19.0±0.50 | 17 | 16.3±0.50 |

## Sexual dimorphism

Table S23. Sexual size dimorphism (SSD and ASSD) of mtt IV in the different forms of cave bears and brown bear; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 86.6±1.00 | 21.6±0.47 | 30.1±0.54 | 16.1±0.39 | 23.9±0.51 | 18.6±0.29 | |
| Females | 79.0±0.51 | 19.9±0.24 | 26.2±0.31 | 14.2±0.15 | 21.6±0.28 | 17.0±0.20 | |
| *SSD* | 4.6±0.68 ($p$<0.001) | 3.9±1.26 ($p$<0.001) | 7.0±1.10 ($p$<0.001) | 6.3±1.38 ($p$<0.001) | 5.1±1.29 ($p$<0.001) | 4.6±1.00 ($p$<0.001) | 5.2 |
| *v, %* | 76.4 | 32.5 | 72.8 | 59.5 | 49.0 | 60.7 | |
| | | | | *U. rossicus* | | | |
| Males | 66.4±0.38 | 17.3±0.43 | 23.0±0.25 | 12.6±0.15 | 18.0±0.14 | 13.8±0.12 | |
| Females | 61.1±0.55 | 16.2±0.25 | 21.2±0.60 | 11.6±0.21 | 17.0±0.27 | 13.1±0.32 | |
| *SSD* | 4.1±0.52 | 3.1±1.49 | 4.2±1.46 | 3.9±1.07 | 3.1±0.88 | n.s. | 3.5 |

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | ($p$<0.001) | ($p$=0.046) | ($p$=0.006) | ($p$=0.002) | ($p$<0.001) | | |
| *v, %* | 77.7 | 55.3 | 63.2 | 59.4 | 76.7 | - | |
| | | | *U. k. praekudarensis* | | | | |
| Males | 95.5±1.22 | 25.8±0.64 | 32.4±0.63 | 17.9±0.28 | 26.8±0.46 | 21.3±0.36 | |
| Females | 82.6±1.12 | 21.5±0.61 | 27.6±0.90 | 15.0±0.27 | 22.3±0.32 | 17.2±0.34 | |
| *SSD* | 7.2±0.93 ($p$<0.001) | 9.1±1.87 ($p$<0.001) | 8.0±1.84 ($p$=0.002) | 8.7±1.20 ($p$<0.001) | 9.1±1.14 ($p$<0.001) | 10.6±1.28 ($p$ =0.001) | 8.8 |
| *v, %* | 90.8 | 81.7 | 72.4 | 83.4 | 94.1 | 90.6 | |
| | | | *U. k. kudarensis* | | | | |
| Males | 96.6±0.50 | 24.4±0.35 | 33.0±0.33 | 18.3±0.17 | 27.2±0.25 | 20.5±0.15 | |
| Females | 88.6±0.57 | 23.9±0.43 | 30.0±0.33 | 16.9±0.20 | 25.0±0.27 | 19.2±0.17 | |
| *SSD* | 4.3±0.41 ($p$<0.001) | n.s. | 4.8±0.74 ($p$<0.001) | 3.9±0.76 ($p$<0.001) | 4.2±0.70 ($p$<0.001) | 3.1±0.58 ($p$<0.001) | 3.5 |
| *v, %* | 73.5 | 0.0 | 43.6 | 32.6 | 39.5 | 44.7 | |
| | | | *U. s. spelaeus* | | | | |
| Males | 93.2±1.51 | 23.5±0.74 | 34.5±1.07 | 17.2±0.41 | 25.4±0.80 | 20.2±0.49 | |
| Females | 83.3±0.79 | 20.5±0.29 | 30.0±0.53 | 15.4±0.29 | 22.4±0.36 | 17.4±0.80 | |
| *SSD* | 5.6±0.97 ($p$<0.001) | 6.8±1.82 (p=0.001) | 7.1±1.86 ($p$=0.003) | 5.3±1.55 ($p$=0.002) | 6.3±1.85 ($p$=0.003) | n.s. | 6.4 |
| *v, %* | 93.1 | 73.4 | 20.2 | 4.8 | 35.9 | - | |
| | | | *U. s. ladinicus* | | | | |
| Males | 91.6±3.05 | 21.1±1.11 | 35.2±1.79 | 16.5±0.71 | 25.3±1.05 | 20.0±0.10 | |
| Females | 79.3±1.02 | 18.6±0.40 | 28.9±0.62 | 13.3±0.23 | 21.2±0.44 | 17.1±0.21 | |
| *SSD* | 7.2±1.89 ($p$=0.009) | 6.2±2.98 ($p$=0.036) | 9.9±2.97 ($p$=0.018) | 11.0±2.51 ($p$=0.009) | 8.8±2.45 ($p$=0.009) | n.s. | 8.5 |
| *v, %* | 91.3 | 54.3 | 92.1 | 93.3 | 92.4 | - | |
| | | | *U. s. eremus* | | | | |
| Males | 92.3±0.74 | 21.2±0.31 | 35.6±0.76 | 17.4±0.49 | 25.8±0.31 | 20.3±0.31 | |
| Females | 83.6±0.78 | 19.5±0.24 | 30.7±0.66 | 14.8±0.24 | 22.8±0.26 | 18.5±0.22 | |
| *SSD* | 5.0±0.61 ($p$<0.001) | 4.2±0.98 ($p$<0.001) | 7.4±1.52 ($p$<0.001) | 8.1±1.70 ($p$<0.001) | 6.2±0.84 ($p$<0.001) | 4.8±0.99 ($p$<0.001) | 6.0 |
| *v, %* | 85.2 | 64.9 | 69.5 | 75.9 | 84.4 | 71.9 | |
| | | | *U. k. ingressus* | | | | |
| Males | 93.5±1.05 | 23.8±0.98 | 33.8±1.31 | 18.2±0.25 | 26.0±0.24 | 19.6±0.23 | |
| Females | 84.4±0.64 | 22.1±0.36 | 31.1±0.46 | 15.4±0.18 | 22.6±0.26 | 18.0±0.25 | |
| *SSD* | 5.1±0.70 ($p$<0.001) | n.s. | n.s. | 8.5±0.92 ($p$<0.001) | 7.0±0.73 ($p$<0.001) | 4.1±0.90 ($p$<0.001) | 5.4 |
| *v, %* | 78.1 | - | - | 63.2 | 57.9 | 41.0 | |
| | | | *U. kanivetz* | | | | |
| Males | 92.0±1.99 | 21.9±0.43 | 33.3±1.19 | 17.8±0.15 | 26.3±0.45 | 19.9±0.50 | |
| Females | 79.4±1.00 | 19.6±0.50 | 27.9±0.58 | 15.4±0.30 | 21.9±0.28 | 16.6±0.27 | |
| *SSD* | 7.4±1.30 ($p$<0.001) | 5.5±1.59 ($p$=0.006) | 8.7±2.17 ($p$=0.001) | 7.1±1.01 ($p$=0.001) | 9.2±1.11 ($p$<0.001) | 9.0±1.57 ($p$=0.001) | 7.8 |
| *v, %* | 86.0 | 66.7 | 77.4 | 83.2 | 88.2 | 83.5 | |
| | | | *U. arctos* | | | | |
| Males | 90.4±2.60 | 21.0±0.86 | 28.1±0.89 | 14.1±0.38 | 21.2±0.55 | 17.7±0.50 | |
| Females | 79.7±1.37 | 17.1±0.31 | 23.1±0.86 | 11.3±0.26 | 17.3±0.31 | 14.7±0.41 | |
| *SSD* | 6.3±1.73 ($p$=0.001) | 10.0±2.40 ($p$<0.001) | 9.7±2.43 ($p$<0.001) | 11.2±1.82 ($p$<0.001) | 10.2±1.65 ($p$<0.001) | 9.4±2.00 ($p$<0.001) | 9.5 |

## Univariate analysis

Table S24. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for measures of mtt IV. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 1.83 | 3.40 | 5.47 | 1.95 | 2.83 | 1.67 | 1.58 | 1.36 | 1.24 |
| *U. rossicus* | 2 | 2.15 | | 5.09 | 8.17 | 3.36 | 4.85 | 2.97 | 3.06 | 2.41 | 2.91 |
| *U. k. praekudarensis* | 3 | 1.99 | 3.41 | | 0.50 | 0.93 | 1.05 | 1.03 | 1.42 | 0.86 | 2.02 |
| *U. k. kudarensis* | 4 | 7.01 | 7.62 | 2.59 | | 1.56 | 2.18 | 1.61 | 2.22 | 1.27 | 3.19 |
| *U. s. spelaeus* | 5 | 2.93 | 4.37 | 0.40 | 2.63 | | 0.12 | 0.14 | 0.40 | 0.12 | 0.84 |
| *U. k. ingressus* | 6 | 4.30 | 5.55 | 0.73 | 3.20 | 0.34 | | 0.28 | 0.62 | 0.23 | 1.24 |
| *U. k. kanivetz* | 7 | 0.51 | 2.42 | 1.51 | 5.66 | 2.28 | 3.24 | | 0.24 | 0.00 | 0.64 |
| *U. s. eremus* | 8 | 3.10 | 4.53 | 0.47 | 2.61 | 0.08 | 0.25 | 2.42 | | 0.20 | 0.43 |
| *U. s. ladinicus* | 9 | 0.35 | 2.09 | 1.44 | 4.78 | 2.07 | 2.75 | 0.07 | 2.18 | | 0.54 |
| *U. arctos* | 10 | 0.83 | 2.63 | 1.22 | 5.03 | 1.90 | 2.71 | 0.31 | 2.03 | 0.34 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 2.74 | 3.51 | 3.16 | 1.47 | 1.69 | 0.26 | 0.41 | 0.30 | 0.48 |
| *U. rossicus* | 2 | 3.14 | | 6.04 | 6.50 | 3.59 | 3.81 | 2.26 | 1.85 | 1.35 | 2.04 |
| *U. k. praekudarensis* | 3 | 1.57 | 3.86 | | 1.43 | 1.38 | 1.17 | 2.38 | 3.33 | 2.47 | 3.69 |
| *U. k. kudarensis* | 4 | 4.67 | 6.29 | 1.49 | | 0.53 | 0.28 | 1.73 | 2.83 | 1.91 | 3.32 |
| *U. s. spelaeus* | 5 | 0.66 | 3.34 | 0.90 | 3.00 | | 0.19 | 0.96 | 1.63 | 1.28 | 1.77 |
| *U. k. ingressus* | 6 | 2.88 | 5.08 | 0.62 | 1.11 | 1.81 | | 1.14 | 1.82 | 1.43 | 1.98 |
| *U. k. kanivetz* | 7 | 0.56 | 2.62 | 1.92 | 4.84 | 1.10 | 3.21 | | 0.56 | 0.44 | 0.61 |
| *U. s. eremus* | 8 | 0.65 | 2.41 | 1.93 | 4.53 | 1.15 | 3.11 | 0.12 | | 0.00 | 0.01 |
| *U. s. ladinicus* | 9 | 1.57 | 1.46 | 2.60 | 4.99 | 1.93 | 3.74 | 1.06 | 0.91 | | 0.01 |
| *U. arctos* | 10 | 3.21 | 0.52 | 3.90 | 7.31 | 3.36 | 5.55 | 2.53 | 2.26 | 1.14 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 2.36 | 1.84 | 3.13 | 2.76 | 2.35 | 1.95 | 3.87 | 2.48 | 0.77 |
| *U. rossicus* | 2 | 1.71 | | 3.91 | 5.97 | 4.46 | 4.17 | 3.66 | 5.77 | 3.89 | 1.40 |
| *U. k. praekudarensis* | 3 | 1.19 | 2.39 | | 0.43 | 1.17 | 0.69 | 0.42 | 2.00 | 1.19 | 2.41 |
| *U. k. kudarensis* | 4 | 5.02 | 5.08 | 2.19 | | 1.06 | 0.48 | 0.16 | 2.12 | 1.07 | 3.65 |
| *U. s. spelaeus* | 5 | 3.10 | 3.91 | 1.58 | 0.17 | | 0.48 | 0.66 | 0.61 | 0.20 | 3.21 |
| *U. k. ingressus* | 6 | 5.23 | 5.41 | 2.79 | 1.17 | 0.95 | | 0.22 | 1.16 | 0.61 | 2.84 |
| *U. k. kanivetz* | 7 | 1.63 | 2.81 | 0.14 | 2.52 | 1.63 | 3.13 | | 1.33 | 0.77 | 2.44 |
| *U. s. eremus* | 8 | 4.56 | 4.99 | 2.45 | 0.78 | 0.70 | 0.25 | 2.70 | | 0.31 | 4.29 |
| *U. s. ladinicus* | 9 | 2.30 | 3.28 | 0.86 | 1.18 | 0.77 | 1.89 | 0.82 | 1.58 | | 2.89 |
| *U. arctos* | 10 | 1.23 | 0.46 | 2.00 | 4.76 | 3.57 | 5.12 | 2.40 | 4.68 | 2.91 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 2.33 | 2.43 | 4.11 | 1.02 | 3.68 | 1.55 | 1.39 | 0.20 | 1.50 |
| *U. rossicus* | 2 | 2.10 | | 4.51 | 6.76 | 2.79 | 5.94 | 3.20 | 3.24 | 1.58 | 0.65 |
| *U. k. praekudarensis* | 3 | 1.46 | 2.91 | | 0.69 | 0.93 | 0.88 | 0.30 | 0.68 | 1.29 | 3.61 |
| *U. k. kudarensis* | 4 | 6.41 | 6.31 | 2.80 | | 1.63 | 0.40 | 0.84 | 1.39 | 1.80 | 5.26 |
| *U. s. spelaeus* | 5 | 2.49 | 3.77 | 0.63 | 2.43 | | 1.71 | 0.51 | 0.25 | 0.52 | 2.14 |
| *U. k. ingressus* | 6 | 3.09 | 4.19 | 0.56 | 3.81 | 0.21 | | 0.99 | 1.49 | 1.89 | 4.81 |
| *U. k. kanivetz* | 7 | 2.52 | 3.81 | 0.48 | 3.03 | 0.21 | 0.04 | | 0.28 | 0.93 | 2.58 |
| *U. s. eremus* | 8 | 1.19 | 2.81 | 0.41 | 3.97 | 1.18 | 1.26 | 1.06 | | 0.74 | 2.53 |
| *U. s. ladinicus* | 9 | 1.27 | 0.81 | 2.26 | 5.91 | 3.14 | 3.55 | 3.16 | 2.10 | | 1.12 |
| *U. arctos* | 10 | 2.70 | 0.06 | 3.41 | 8.19 | 4.55 | 5.45 | 4.72 | 3.44 | 1.01 | |
| | | | | | Bd | | | | | | |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. deningeri* | 1 | | 2.63 | 2.61 | 4.21 | 0.96 | 2.04 | 1.67 | 1.34 | 0.80 | 1.41 |
| *U. rossicus* | 2 | 3.11 | | 4.94 | 8.00 | 2.99 | 4.95 | 3.57 | 3.50 | 2.32 | 0.90 |
| *U. k. praekudarensis* | 3 | 0.95 | 3.24 | | 0.33 | 1.27 | 0.99 | 0.51 | 1.04 | 0.96 | 3.68 |
| *U. k. kudarensis* | 4 | 5.46 | 7.45 | 2.62 | | 1.87 | 1.93 | 0.88 | 1.63 | 1.30 | 5.36 |
| *U. s. spelaeus* | 5 | 1.13 | 3.67 | 0.01 | 3.12 | | 0.56 | 0.66 | 0.27 | 0.05 | 2.05 |
| *U. k. ingressus* | 6 | 1.77 | 4.66 | 0.16 | 4.25 | 0.18 | | 0.26 | 0.25 | 0.36 | 3.31 |
| *U. k. kanivetz* | 7 | 0.28 | 3.10 | 0.68 | 4.41 | 0.80 | 1.22 | | 0.42 | 0.49 | 2.65 |
| *U. s. eremus* | 8 | 1.80 | 4.32 | 0.47 | 2.66 | 0.52 | 0.47 | 1.39 | | 0.16 | 2.45 |
| *U. s. ladinicus* | 9 | 0.41 | 2.23 | 1.14 | 4.42 | 1.29 | 1.72 | 0.60 | 1.83 | | 1.66 |
| *U. arctos* | 10 | 3.23 | 0.14 | 3.29 | 8.04 | 3.78 | 4.97 | 3.18 | 4.49 | 2.23 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 2.29 | 3.94 | 3.97 | 1.68 | 1.46 | 1.39 | 2.47 | 1.14 | 0.65 |
| *U. rossicus* | 2 | 2.67 | | 5.61 | 6.22 | 3.03 | 3.63 | 2.90 | 4.22 | 2.30 | 1.42 |
| *U. k. praekudarensis* | 3 | 0.41 | 2.44 | | 1.52 | 1.08 | 2.78 | 1.63 | 1.26 | 1.18 | 4.12 |
| *U. k. kudarensis* | 4 | 5.18 | 6.30 | 2.90 | | 0.21 | 2.19 | 0.78 | 0.13 | 0.45 | 3.99 |
| *U. s. spelaeus* | 5 | 0.42 | 1.84 | 0.15 | 1.62 | | 0.83 | 0.37 | 0.10 | 0.22 | 2.00 |
| *U. k. ingressus* | 6 | 2.33 | 4.33 | 1.13 | 2.76 | 0.54 | | 0.44 | 1.31 | 0.43 | 1.91 |
| *U. k. kanivetz* | 7 | 0.66 | 1.90 | 0.86 | 4.90 | 0.73 | 2.59 | | 0.56 | 0.09 | 1.75 |
| *U. s. eremus* | 8 | 2.95 | 4.71 | 1.72 | 1.36 | 0.96 | 0.95 | 3.14 | | 0.34 | 2.79 |
| *U. s. ladinicus* | 9 | 0.10 | 2.26 | 0.26 | 3.44 | 0.33 | 1.54 | 0.60 | 2.13 | | 1.45 |
| *U. arctos* | 10 | 2.34 | 0.38 | 2.15 | 6.15 | 1.62 | 4.07 | 1.56 | 4.48 | 1.96 | |

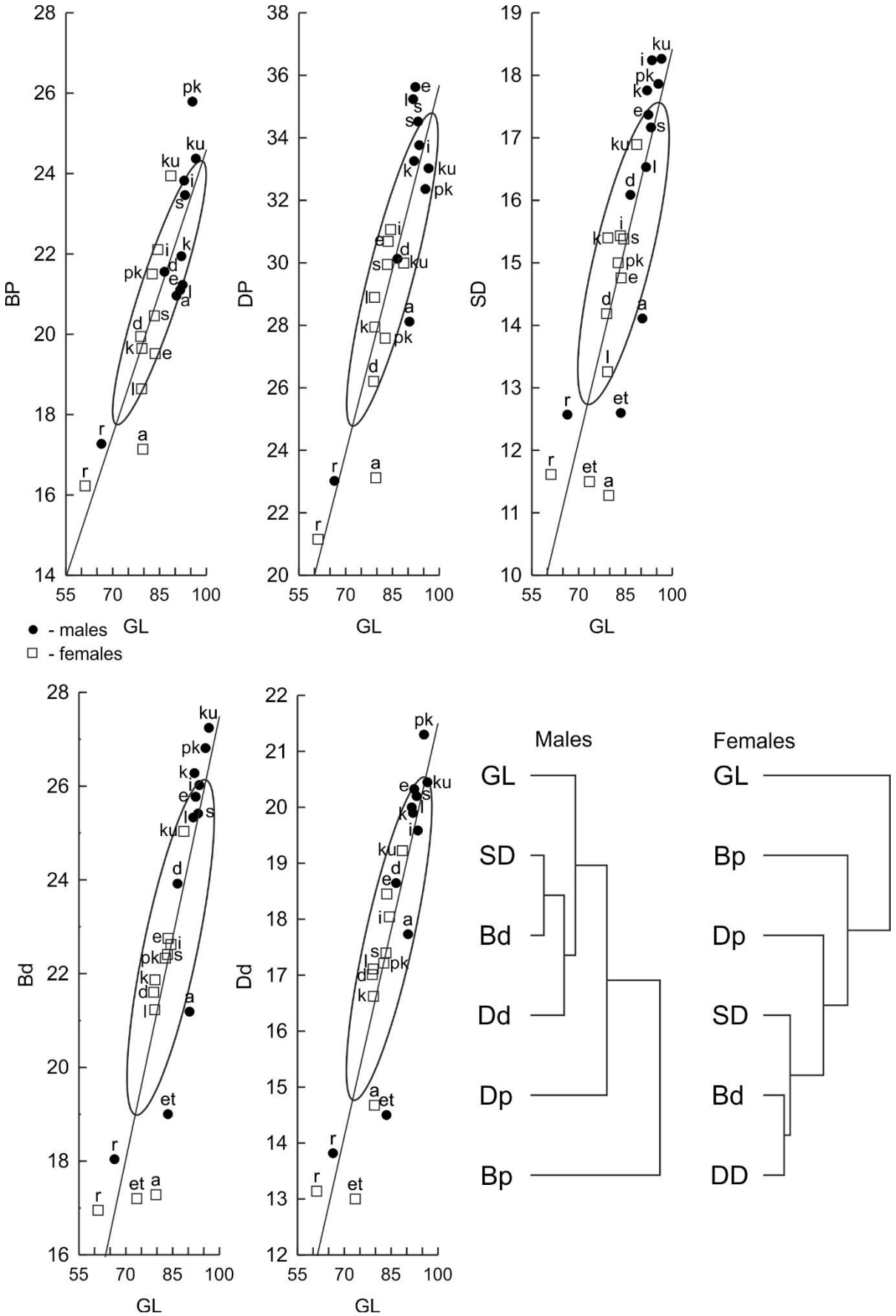


Fig. S16. The scatterplots of measures (GL – Dd) of mtt IV and their UPMGA classification, and single linkage dendrograms of measurements based on the correlation metric. et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus.*

Table S25. Statistical parameters of measures of mtt IV among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | GL Std.De | Bp - N | Bp | Bp Std.De | Dp - N | Dp | Dp Std.De | SD - N | SD | SD Std.De | Bd - N | Bd | Bd Std.De | Dd- N | Dd | Dd Std.De |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | m | 1 | 73.5 | | | | | | | | 1 | 11.5 | | 1 | 17.2 | | 1 | 13.0 | |
| | f | 1 | 83.5 | | | | | | | | 1 | 12.6 | | 1 | 19.0 | | 1 | 14.5 | |
| *U. rossicus* | f | 10 | 61.1 | 0.55 | 7 | 16.2 | 0.25 | 7 | 21.2 | 0.60 | 7 | 11.6 | 0.21 | 10 | 17.0 | 0.27 | 7 | 13.1 | 0.32 |
| | m | 18 | 66.4 | 0.38 | 13 | 17.3 | 0.43 | 13 | 23.0 | 0.25 | 13 | 12.6 | 0.15 | 18 | 18.0 | 0.14 | 11 | 13.8 | 0.12 |
| *U. deningeri* | f | 22 | 79.0 | 0.51 | 23 | 19.9 | 0.24 | 22 | 26.2 | 0.31 | 23 | 14.2 | 0.15 | 22 | 21.6 | 0.28 | 21 | 17.0 | 0.20 |
| | m | 15 | 86.6 | 1.00 | 14 | 21.6 | 0.47 | 14 | 30.1 | 0.54 | 15 | 16.1 | 0.39 | 14 | 23.9 | 0.51 | 15 | 18.6 | 0.29 |
| *U. k. praekudarensis* | f | 7 | 82.6 | 1.12 | 8 | 21.5 | 0.61 | 8 | 27.6 | 0.90 | 8 | 15.0 | 0.27 | 7 | 22.3 | 0.32 | 6 | 17.2 | 0.34 |
| | m | 9 | 95.5 | 1.22 | 11 | 25.8 | 0.64 | 9 | 32.4 | 0.63 | 11 | 17.9 | 0.28 | 8 | 26.8 | 0.46 | 7 | 21.3 | 0.36 |
| *U. k. kudarensis* | f | 32 | 88.6 | 0.57 | 40 | 23.9 | 0.43 | 38 | 30.0 | 0.33 | 39 | 16.9 | 0.20 | 33 | 25.0 | 0.27 | 28 | 19.2 | 0.17 |
| | m | 48 | 96.6 | 0.50 | 56 | 24.4 | 0.35 | 52 | 33.0 | 0.33 | 57 | 18.3 | 0.17 | 46 | 27.2 | 0.25 | 44 | 20.5 | 0.15 |
| *U. s. spelaeus* | f | 12 | 83.3 | 0.79 | 12 | 20.5 | 0.29 | 8 | 30.0 | 0.53 | 12 | 15.4 | 0.29 | 11 | 22.4 | 0.36 | 2 | 17.4 | 0.80 |
| | m | 6 | 93.2 | 1.51 | 6 | 23.5 | 0.74 | 5 | 34.5 | 1.07 | 6 | 17.2 | 0.41 | 6 | 25.4 | 0.80 | 3 | 20.2 | 0.49 |
| *U. k. ingressus* | f | 36 | 84.4 | 0.64 | 18 | 22.1 | 0.36 | 17 | 31.1 | 0.46 | 38 | 15.4 | 0.18 | 36 | 22.6 | 0.26 | 22 | 18.0 | 0.25 |
| | m | 17 | 93.5 | 1.05 | 6 | 23.8 | 0.98 | 6 | 33.8 | 1.31 | 17 | 18.2 | 0.25 | 17 | 26.0 | 0.24 | 15 | 19.6 | 0.23 |
| *U. k. kanivetz* | f | 15 | 79.4 | 1.00 | 17 | 19.6 | 0.50 | 14 | 27.9 | 0.58 | 17 | 15.4 | 0.30 | 14 | 21.9 | 0.28 | 11 | 16.6 | 0.27 |
| | m | 5 | 92.0 | 1.99 | 5 | 21.9 | 0.43 | 5 | 33.3 | 1.19 | 5 | 17.8 | 0.15 | 5 | 26.3 | 0.45 | 4 | 19.9 | 0.50 |
| *U. s. eremus* | f | 13 | 83.6 | 0.78 | 13 | 19.5 | 0.24 | 13 | 30.7 | 0.66 | 13 | 14.8 | 0.24 | 13 | 22.8 | 0.26 | 13 | 18.5 | 0.22 |
| | m | 7 | 92.3 | 0.74 | 7 | 21.2 | 0.31 | 7 | 35.6 | 0.76 | 7 | 17.4 | 0.49 | 7 | 25.8 | 0.31 | 7 | 20.3 | 0.31 |
| *U. s. ladinicus* | f | 9 | 79.3 | 1.02 | 9 | 18.6 | 0.40 | 9 | 28.9 | 0.62 | 9 | 13.3 | 0.23 | 9 | 21.2 | 0.44 | 7 | 17.1 | 0.21 |
| | m | 3 | 91.6 | 3.05 | 3 | 21.1 | 1.11 | 3 | 35.2 | 1.79 | 3 | 16.5 | 0.71 | 3 | 25.3 | 1.05 | 2 | 20.0 | 0.10 |
| *U. arctos* | f | 13 | 79.7 | 1.37 | 13 | 17.1 | 0.31 | 8 | 23.1 | 0.86 | 13 | 11.3 | 0.26 | 13 | 17.3 | 0.31 | 8 | 14.7 | 0.41 |
| | m | 10 | 90.4 | 2.60 | 10 | 21.0 | 0.86 | 10 | 28.1 | 0.89 | 10 | 14.1 | 0.38 | 10 | 21.2 | 0.55 | 9 | 17.7 | 0.50 |

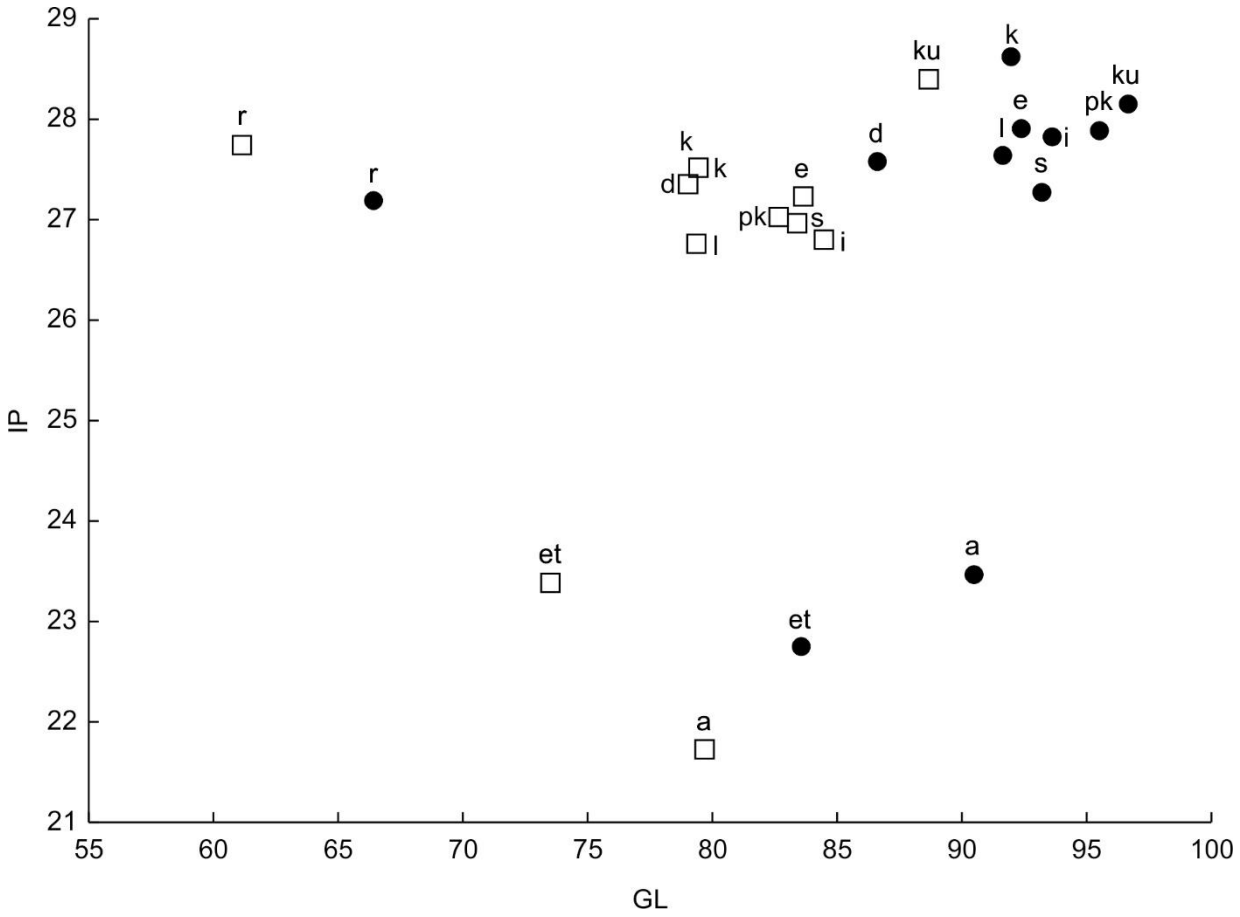


Fig. S17. The scatterplot of Index plumpness (ip) and GL of mtt IV: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females.

## Multivariate analysis

Table 26. Description of the modeled morphological spaces for cave bears and brown bear mtt IV. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.92 | -0.09 | -0.06 | -0.02 | 0.88 | 0.96 | 0.08 | 0.04 | 0.47 | 0.92 |
| Bp | 0.84 | -0.45 | 0.10 | -0.40 | 0.94 | 0.82 | -0.49 | -0.43 | 0.23 | 0.98 |
| Dp | 0.88 | 0.22 | -0.10 | 0.29 | 0.91 | 0.86 | 0.32 | 0.34 | 0.21 | 0.92 |
| SD | 0.93 | 0.20 | -0.40 | -0.06 | 0.93 | 0.93 | 0.16 | 0.07 | 0.56 | 0.89 |
| Bd | 0.96 | 0.15 | -0.33 | -0.08 | 0.96 | 0.97 | 0.15 | 0.03 | 0.60 | 0.96 |
| Dd | 0.96 | 0.04 | -0.15 | -0.07 | 0.92 | 0.95 | 0.11 | -0.02 | 0.47 | 0.92 |
| ip | 0.32 | 0.26 | -0.53 | -0.23 | | 0.33 | 0.15 | -0.06 | 0.53 | |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 69.4 | 29.9 | 15.8 | 38.1 | | 69.9 | 25.5 | 29.8 | 37.3 | |

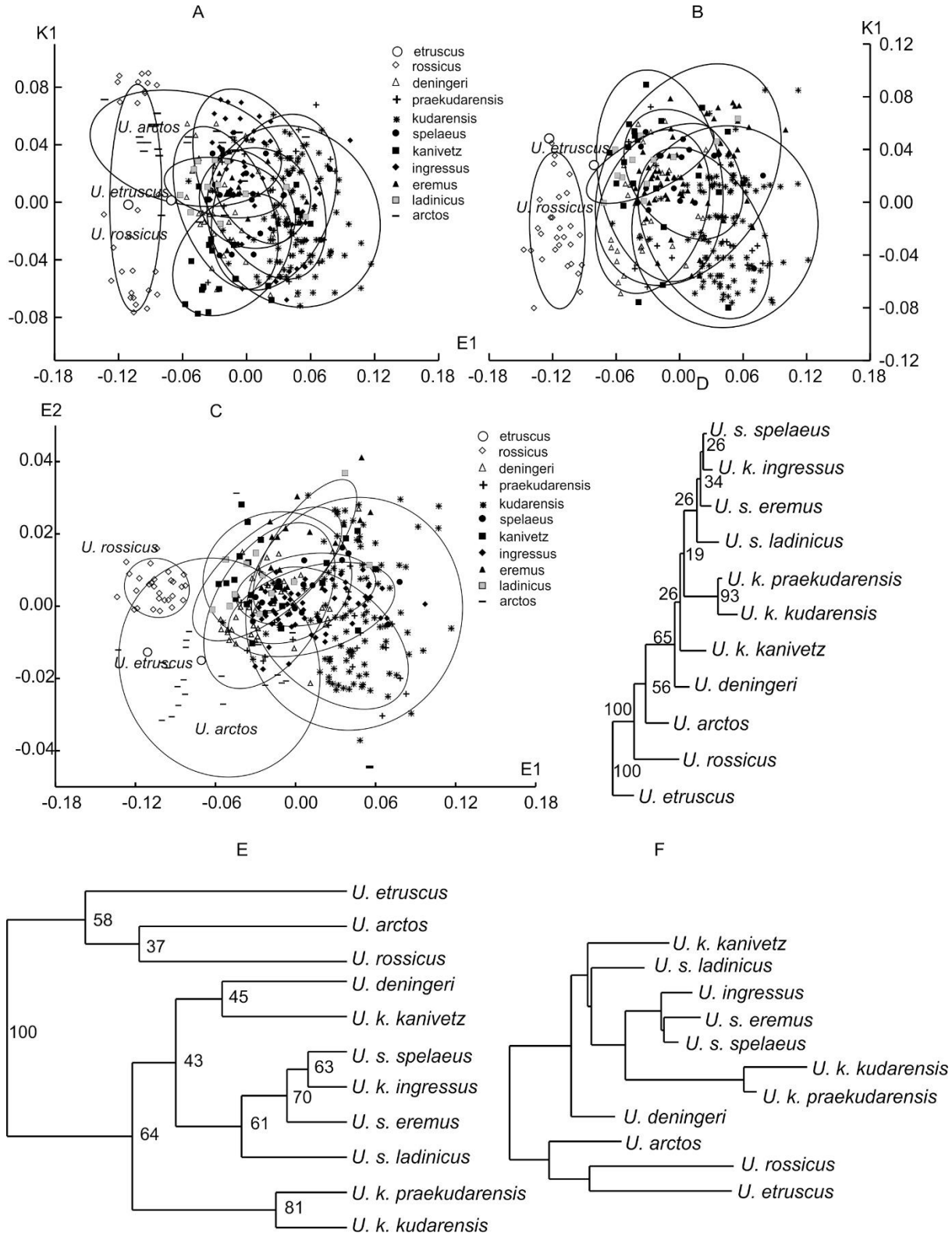


Fig. S18. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt IV in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.85); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S27. Description of the modeled morphological spaces for males of cave bears and brown bear metatarsal IV. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K3); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E | K1 | K2 | | E | K1 | K2 | |
| GL | 0.93 | 0.42 | 0.46 | 0.88 | 0.96 | 0.46 | 0.51 | 0.92 |
| Bp | 0.78 | -0.05 | 0.55 | 0.89 | 0.77 | -0.10 | 0.61 | 0.91 |
| Dp | 0.87 | 0.59 | 0.04 | 0.91 | 0.86 | 0.63 | 0.09 | 0.91 |
| SD | 0.92 | 0.57 | 0.39 | 0.87 | 0.93 | 0.55 | 0.48 | 0.87 |
| Bd | 0.96 | 0.59 | 0.48 | 0.94 | 0.96 | 0.56 | 0.55 | 0.94 |
| Dd | 0.97 | 0.50 | 0.49 | 0.93 | 0.97 | 0.50 | 0.54 | 0.92 |
| ip | 0.34 | 0.43 | 0.33 | | 0.33 | 0.33 | 0.28 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | |
| | 88.5 | 42.5 | 40.9 | | 91.7 | 39.5 | 41.3 | |

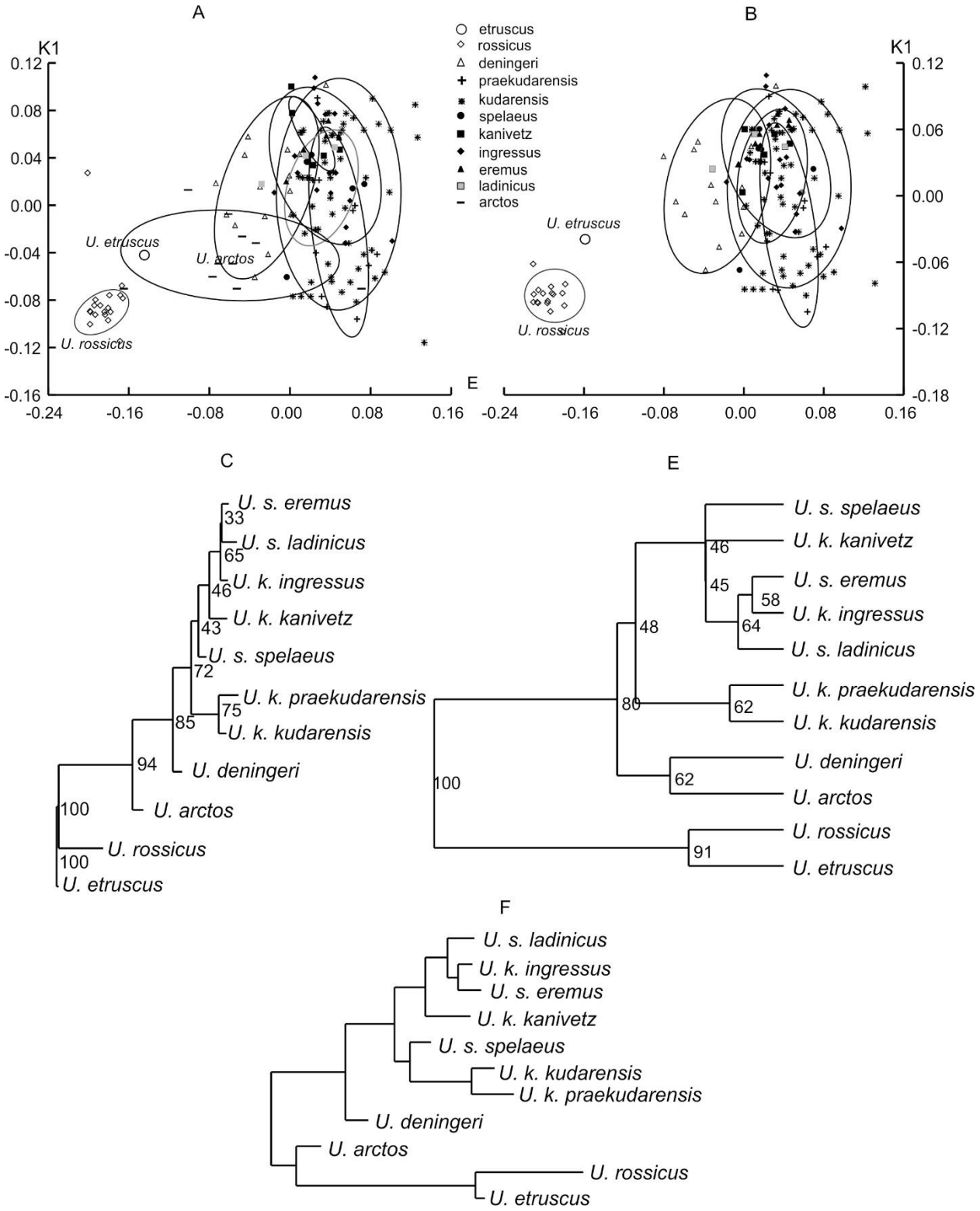


Fig. S19. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt IV in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.89); D – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E, E1, and E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S28. Description of the modeled morphological spaces for females of cave bears and brown bear mtt IV. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | Morphospaces without *U. arctos* | | | |
|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | "Shape" morphospace | | $r^2$ | "Size" morphospace | "Shape" morphospace | | $r^2$ |
| | E | K1 | K2 | | E | K1 | K2 | |
| GL | 0.88 | -0.04 | 0.35 | 0.82 | 0.95 | 0.25 | 0.29 | 0.88 |
| Bp | 0.84 | -0.24 | 0.36 | 0.79 | 0.82 | 0.38 | -0.08 | 0.81 |
| Dp | 0.85 | 0.32 | 0.03 | 0.90 | 0.81 | -0.26 | 0.22 | 0.88 |
| SD | 0.90 | -0.29 | -0.18 | 0.93 | 0.89 | 0.30 | 0.55 | 0.87 |
| Bd | 0.95 | -0.24 | -0.04 | 0.94 | 0.95 | 0.35 | 0.45 | 0.92 |
| Dd | 0.93 | -0.08 | 0.18 | 0.88 | 0.92 | 0.19 | 0.26 | 0.85 |
| ip | 0.25 | -0.43 | -0.37 | | 0.26 | 0.30 | 0.41 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | |
| | 82.5 | 51.8 | 33.1 | | 79.5 | 52.6 | 24.0 | |

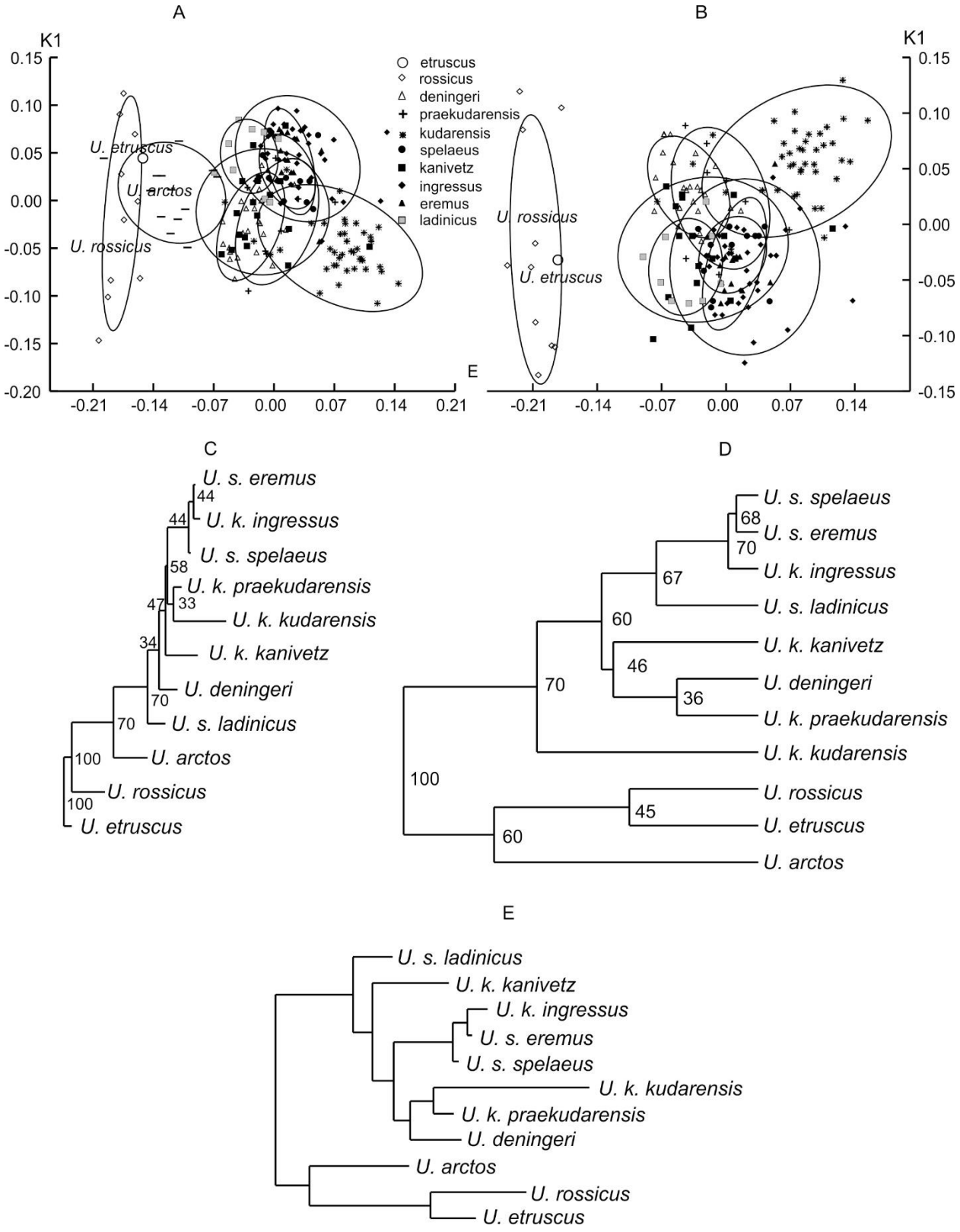


Fig. S20. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt IV in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.89); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

# METATARSAL BONE V (MTT V)

## Males and females

Table S29. Sample numbers (N), means (M), and standard errors (m) of the variables of mtt V among different forms of bears

| Form | GL | | Bp | | Dp | | SD | |
|---|---|---|---|---|---|---|---|---|
| | N | M±m | N | M±m | N | M±m | N | M±m |
| *U. etruscus* | 1 | 75.5 | | | | | 1 | 10.5 |
| *U. savini* | 1 | 76.1 | 1 | 28.0 | 1 | 29.2 | 1 | 13.9 |
| *U. deningeri* | 33 | 83.5±1.12 | 30 | 28.4±0.60 | 33 | 30.5±0.67 | 35 | 13.6±0.24 |
| *U. k. praekudarensis* | 17 | 92.1±1.39 | 17 | 31.0±0.81 | 18 | 31.0±0.71 | 22 | 15.3±0.33 |
| *U. k. kudarensis* | 45 | 93.4±0.61 | 56 | 33.6±0.30 | 58 | 34.1±0.39 | 60 | 16.1±0.15 |
| *U. rossicus* | 17 | 64.6±0.61 | 13 | 23.4±0.36 | 14 | 25.1±0.51 | 15 | 11.2±0.15 |
| *U. s. spelaeus* | 11 | 90.0±2.24 | 9 | 28.4±0.89 | 11 | 28.6±0.56 | 11 | 14.1±0.44 |
| *U. k. kanivetz* | 36 | 81.6±1.11 | 35 | 28.8±0.52 | 35 | 33.4±0.63 | 36 | 13.7±0.28 |
| *U. s. eremus* | 20 | 87.1±1.38 | 20 | 29.5±0.69 | 20 | 31.3±0.89 | 20 | 13.6±0.33 |
| *U. s. ladinicus* | 8 | 79.5±1.05 | 6 | 25.6±0.47 | 8 | 27.3±0.96 | 8 | 12.4±0.24 |
| *U. k. ingressus* | 37 | 90.8±0.91 | 13 | 30.5±0.82 | 13 | 31.3±1.06 | 37 | 14.2±0.19 |
| *U. arctos* | 23 | 86.8±2.39 | 21 | 24.4±0.93 | 18 | 27.0±1.15 | 23 | 11.9±0.43 |

| | Bd | | Dd | |
|---|---|---|---|---|
| | N | M±m | N | M±m |
| *U. etruscus* | 1 | 17.5 | 1 | 13.4 |
| *U. savini* | 1 | 22.3 | 1 | 15.1 |
| *U. deningeri* | 35 | 22.9±0.38 | 34 | 17.7±0.25 |
| *U. k. praekudarensis* | 19 | 25.0±0.60 | 21 | 19.4±0.48 |
| *U. k. kudarensis* | 44 | 25.9±0.25 | 43 | 20.0±0.17 |
| *U. rossicus* | 18 | 18.4±0.17 | 14 | 13.6±0.14 |
| *U. s. spelaeus* | 11 | 23.6±0.67 | 5 | 18.4±0.51 |
| *U. k. kanivetz* | 36 | 27.7±0.50 | 33 | 19.9±0.34 |
| *U. s. eremus* | 20 | 23.7±0.42 | 19 | 18.8±0.30 |
| *U. s. ladinicus* | 7 | 21.0±0.47 | 7 | 17.4±0.27 |
| *U. k. ingressus* | 36 | 24.2±0.33 | 30 | 19.1±0.23 |
| *U. arctos* | 23 | 19.8±0.57 | 17 | 16.0±0.53 |

## Sexual size dimorphism

Table S30. Sexual size dimorphism (*SSD* and *ASSD*) of mtt V in the different forms of cave bears and brown bear; *p* based on Mann-Whitney U Test; *v*, % - relative variance associated with SSD.

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| | | | | *U. deningeri* | | | |
| Males | 91.7±1.66 | 32.0±0.58 | 34.2±1.19 | 15.0±0.49 | 25.0±0.63 | 19.1±0.36 | |
| Females | 79.9±0.48 | 26.6±0.47 | 28.9±0.56 | 13.0±0.19 | 22.1±0.34 | 17.1±0.22 | |
| *SSD* | 6.9±1.01 ($p$<0.001) | 9.2±1.28 ($p$ <0.001) | 8.3±2.09 ($p$ <0.001) | 6.9±1.87 ($p$ <0.001) | 6.3±1.53 ($p$ <0.001) | 5.7±1.18 ($p$ <0.001) | 7.2 |
| *v, %* | 85.2 | 77.9 | 55.4 | 56.9 | 53.8 | 58.9 | |
| | | | | *U. rossicus* | | | |
| Males | 66.1±0.44 | 23.5±0.37 | 24.9±0.59 | 11.2±0.16 | 18.4±0.24 | 13.6±0.17 | |
| Females | 61.9±0.55 | 23.3±1.13 | 25.7±1.12 | 11.1±0.45 | 18.3±0.24 | 13.6±0.23 | |
| *SSD* | 3.3±0.55 ($p$=0.001) | n.s. | n.s. | n.s. | n.s. | n.s. | 0.6 |
| *v, %* | 82.7 | - | - | - | - | - | |
| | | | | *U. k. praekudarensis* | | | |
| Males | 94.9±1.15 | 32.9±0.4 | 32.1±1.75 | 16.4±0.20 | 26.5±0.36 | 20.2±0.48 | |
| Females | 85.4±1.19 | 26.6±0.98 | 28.2±0.79 | 15.6±0.18 | 22.0±0.81 | 17.5±0.79 | |
| *SSD* | 5.3±0.92 ($p$=0.003) | 10.5±1.9 ($p$=0.002) | 6.5±1.82 ($p$=0.014) | 9.1±1.84 ($p$=0.002) | 9.3±1.83 ($p$ <0.001) | 7.3±2.46 ($p$ =0.017) | 8.0 |
| *v, %* | 82.7 | 86.1 | 44.4 | 76.4 | 77.1 | 28.8 | |
| | | | | *U. k. kudarensis* | | | |
| Males | 95.8±0.44 | 34.7±0.36 | 34.9±0.52 | 19.9±0.22 | 26.4±0.26 | 20.2±0.21 | |
| Females | 88.9±0.58 | 32.1±0.33 | 32.9±0.49 | 17.1±0.5 | 25.0±0.41 | 19.6±0.26 | |
| *SSD* | 3.7±0.40 ($p$<0.001) | 3.8±0.73 ($p$<0.001) | 3.0±1.1 ($p$=0.011) | 2.2±0.83 ($p$=0.02) | 2.8±0.95 ($p$=0.004) | 1.7±0.83 ($p$=0.03) | 2.9 |
| *v, %* | 81.9 | 38.1 | 6.4 | 12.6 | 25.0 | 13.4 | |
| | | | | *U. s. spelaeus* | | | |
| Males | 95.8±1.61 | 30.0±0.91 | 29.8±0.50 | 15.2±0.27 | 25.3±0.46 | 20.0* | |
| Females | 83.1±1.37 | 27.2±1.24 | 27.2±1.24 | 12.8±0.40 | 21.6±0.44 | 18.0±0.41 | |
| *SSD* | 7.1±1.18 ($p$=0.008) | n.s. | 4.8±1.38 ($p$=0.02) | 8.6±1.73 ($p$=0.008) | 8.0±1.36 ($p$=0.008) | n.s. | 6.5 |
| *v, %* | 87.5 | 0.0 | 54.6 | 33.2 | 73.9 | - | |
| | | | | *U. s. ladinicus* | | | |
| Males | 81.8±0.65 | 26.8±0.90 | 29.4±1.07 | 12.9±0.33 | 22.2±0.23 | 17.7±0.41 | |
| Females | 77.2±1.09 | 25.0±0.28 | 25.3±0.57 | 12.0±0.17 | 20.1±0.36 | 16.9±0.07 | |
| *SSD* | 2.9±0.08 (p=0.03) | n.s. | 7.5±2.23 (p=0.03) | n.s. | n.s. | n.s. | 4.7 |
| *v, %* | 75.5 | - | 79.0 | - | - | - | |
| | | | | *U. s. eremus* | | | |
| Males | 92.1±1.14 | 32.0±0.65 | 34.9±0.53 | 14.7±0.35 | 25.3±0.22 | 20.0±0.80 | |
| Females | 82.2±1.15 | 27.0±0.52 | 27.7±0.44 | 12.5±0.22 | 22.0±0.32 | 17.6±0.21 | |
| *SSD* | 5.6±0.93 ($p$<0.001) | 8.3±1.32 ($p$<0.001) | 11.5±1.11 ($p$<0.001) | 8.2±1.54 ($p$=0.002) | 6.9±0.82 ($p$<0.001) | 6.3±0.74 ($p$<0.001) | 7.8 |
| *v, %* | 78.3 | 77.2 | 91.5 | 73.3 | 87.4 | 87.9 | |
| | | | | *U. k. ingressus* | | | |
| Males | 95.4±0.73 | 32.9±0.51 | 34.0±1.17 | 15.0±0.18 | 25.8±0.30 | 21.0±0.26 | |
| Females | 86.0±0.55 | 27.8±0.60 | 28.3±0.68 | 13.3±0.20 | 22.6±0.23 | 18.1±0.13 | |

| | Measures | | | | | | *ASSD* |
|---|---|---|---|---|---|---|---|
| | GL | Bp | Dp | SD | Bd | Dd | |
| *SSD* | 5.2±0.50 ($p$<0.001) | 8.4±1.30 ($p$=0.003) | 9.1±2.19 ($p$=0.01) | 5.9±0.95 ($p$<0.001) | 6.5±0.79 ($p$<0.001) | 5.2±0.77 ($p$<0.001) | 6.7 |
| *v, %* | 81.8 | 88.3 | 61.5 | 71.8 | 77.4 | 86.1 | |
| | | | | *U. k. kanivetz* | | | |
| Males | 89.1±0.76 | 32.7±0.39 | 37.4±0.83 | 15.7±0.42 | 30.0±0.95 | 21.1±0.83 | |
| Females | 77.9±0.94 | 27.0±0.33 | 31.6±0.49 | 12.7±0.14 | 26.6±0.43 | 19.3±0.28 | |
| *SSD* | 6.7±0.72 ($p$<0.001) | 9.6±0.86 ($p$<0.001) | 8.5±1.40 ($p$<0.001) | 10.3±1.57 ($p$<0.001) | 6.0±1.84 ($p$=0.002) | 4.2±2.17 ($p$=0.005) | 7.6 |
| *v, %* | 77.0 | 87.6 | 77.4 | 84.7 | 75.4 | 33.9 | |
| | | | | *U. arctos* | | | |
| Males | 92.5±3.51 | 26.7±1.25 | 29.1±1.53 | 13.1±0.58 | 21.4±0.81 | 17.3±0.62 | |
| Females | 82.4±2.80 | 22.6±1.12 | 24.8±1.45 | 11.0±0.51 | 18.6±0.63 | 14.8±0.64 | |
| *SSD* | 5.7±2.57 ($p$=0.02) | 8.3±3.41 ($p$=0.01) | n.s. | 8.5±3.21 ($p$=0.02) | 6.9±2.56 ($p$=0.01) | 7.7±2.78 ($p$=0.002) | 7.5 |
| *v, %* | 12.5 | 21.2 | 27.4 | 19.7 | 23.8 | 45.3 | |

**Univariate analysis**

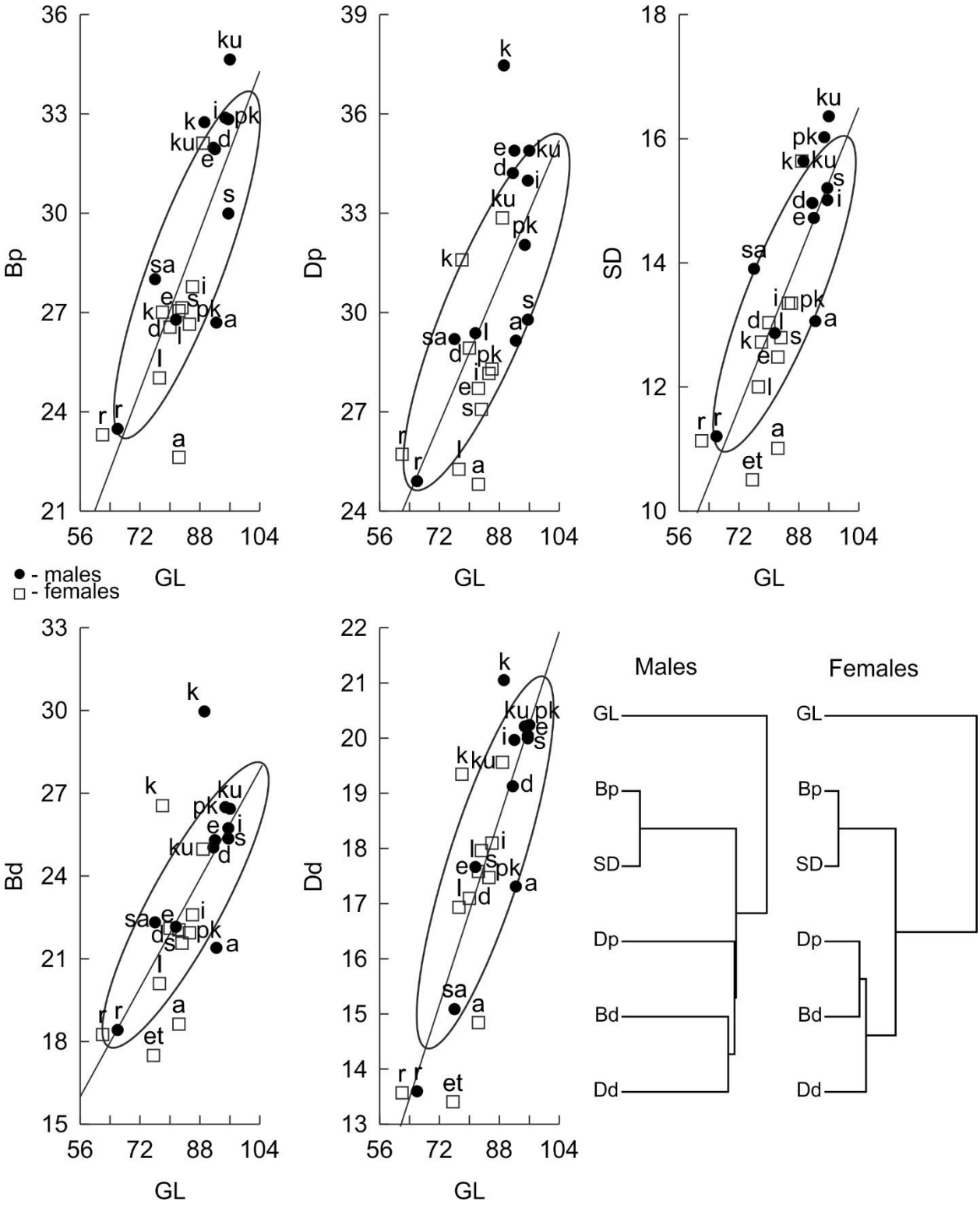


Fig. S21. The scatterplots of measures (GL – Dd) of mtt V and their classification: et – *U. etruscus*, a – *U. arctos*, sa – *U. savini*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*.

Table S31. Statistical parameters of measures of mtt V among different bears and sexes: m – males, f – females.

| Taxa | Sex | GL - N | GL | GL Std.Dev. | Bp - N | Bp | Bp Std.Dev. | Dp - N | Dp | Dp Std.Dev. | SD - N | SD | SD Std.Dev. | Bd - N | Bd | Bd Std.Dev. | Dd- N | Dd | Dd Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. etruscus* | f | 1 | 75.5 | | | | | | | | 1 | 10.5 | | 1 | 17.5 | | 1 | 13.4 | |
| *U. savini* | m | 1 | 76.1 | | 1 | 28.0 | | 1 | 29.2 | 0.00 | 1 | 13.9 | | 1 | 22.3 | | 1 | 15.1 | |
| *U. rossicus* | f | 6 | 61.9 | 1.34 | 3 | 23.3 | 1.95 | 3 | 25.7 | 1.93 | 3 | 11.1 | 0.78 | 6 | 18.3 | 0.59 | 3 | 13.6 | 0.40 |
| | m | 11 | 66.1 | 1.46 | 10 | 23.5 | 1.17 | 11 | 24.9 | 1.97 | 12 | 11.2 | 0.55 | 12 | 18.4 | 0.82 | 11 | 13.6 | 0.55 |
| *U. deningeri* | f | 23 | 79.9 | 2.31 | 20 | 26.6 | 2.09 | 23 | 28.9 | 2.68 | 25 | 13.0 | 0.97 | 25 | 22.1 | 1.72 | 24 | 17.1 | 1.07 |
| | m | 10 | 91.7 | 5.25 | 10 | 32.0 | 1.85 | 10 | 34.2 | 3.76 | 10 | 15.0 | 1.54 | 10 | 25.0 | 2.00 | 10 | 19.1 | 1.15 |
| *U. k. praekudarensis* | f | 5 | 85.4 | 2.65 | 5 | 26.6 | 2.20 | 5 | 28.2 | 1.77 | 6 | 13.4 | 1.19 | 6 | 22.0 | 1.98 | 6 | 17.5 | 1.94 |
| | m | 12 | 94.9 | 4.00 | 12 | 32.9 | 1.38 | 13 | 32.1 | 2.72 | 16 | 16.0 | 0.93 | 13 | 26.5 | 1.30 | 15 | 20.2 | 1.84 |
| *U. k. kudarensis* | f | 16 | 88.9 | 2.32 | 23 | 32.1 | 1.57 | 23 | 32.9 | 2.34 | 23 | 15.6 | 0.85 | 16 | 25.0 | 1.65 | 15 | 19.6 | 1.00 |
| | m | 29 | 95.8 | 2.39 | 33 | 34.7 | 2.06 | 35 | 34.9 | 3.06 | 37 | 16.4 | 1.21 | 28 | 26.4 | 1.40 | 28 | 20.2 | 1.09 |
| *U. s. spelaeus* | f | 5 | 83.1 | 3.06 | 5 | 27.2 | 2.78 | 5 | 27.1 | 1.34 | 5 | 12.8 | 0.90 | 5 | 21.6 | 0.98 | 4 | 18.0 | 0.82 |
| | m | 6 | 95.8 | 3.94 | 4 | 30.0 | 1.62 | 6 | 29.8 | 1.22 | 6 | 15.2 | 0.65 | 6 | 25.3 | 1.13 | 1 | 20.0 | 0.00 |
| *U. k. ingressus* | f | 18 | 86.0 | 2.31 | 6 | 27.8 | 1.47 | 6 | 28.3 | 1.67 | 18 | 13.3 | 0.86 | 18 | 22.6 | 0.99 | 15 | 18.1 | 0.51 |
| | m | 19 | 95.4 | 3.19 | 7 | 32.9 | 1.36 | 7 | 34.0 | 3.10 | 19 | 15.0 | 0.76 | 18 | 25.8 | 1.28 | 15 | 20.1 | 1.01 |
| *U. k. kanivetz* | f | 24 | 77.9 | 4.60 | 24 | 27.0 | 1.60 | 24 | 31.6 | 2.41 | 24 | 12.7 | 0.67 | 24 | 26.6 | 2.12 | 23 | 19.3 | 1.34 |
| | m | 12 | 89.1 | 2.62 | 11 | 32.7 | 1.30 | 11 | 37.4 | 2.75 | 12 | 15.7 | 1.46 | 12 | 30.0 | 3.28 | 10 | 21.1 | 2.63 |
| *U. s. eremus* | f | 10 | 82.2 | 3.64 | 10 | 27.0 | 1.63 | 10 | 27.7 | 1.39 | 10 | 12.5 | 0.71 | 10 | 22.0 | 1.00 | 10 | 17.6 | 0.67 |
| | m | 10 | 92.1 | 3.60 | 10 | 32.0 | 2.06 | 10 | 34.9 | 1.69 | 10 | 14.7 | 1.12 | 10 | 25.3 | 0.70 | 10 | 20.0 | 0.56 |
| *U. s. ladinicus* | f | 4 | 77.2 | 2.18 | 4 | 25.0 | 0.55 | 4 | 25.3 | 1.14 | 4 | 12.0 | 0.35 | 4 | 20.1 | 0.71 | 3 | 16.9 | 0.12 |
| | m | 4 | 81.8 | 1.29 | 2 | 26.8 | 1.27 | 4 | 29.4 | 2.15 | 4 | 12.9 | 0.66 | 3 | 22.2 | 0.40 | 4 | 17.7 | 0.82 |
| *U. arctos* | f | 13 | 82.4 | 10.1 | 12 | 22.6 | 3.87 | 9 | 24.8 | 4.36 | 13 | 11.0 | 1.84 | 13 | 18.6 | 2.28 | 9 | 14.8 | 1.92 |
| | m | 10 | 92.5 | 11.1 | 9 | 26.7 | 3.75 | 9 | 29.1 | 4.60 | 10 | 13.1 | 1.82 | 10 | 21.4 | 2.55 | 8 | 17.3 | 1.75 |

Table S32. Kruskal-Wallis test z' values (males - above diagonal and females – under diagonal) for GL and BP of mtt V between bear taxa. The statistical significance values, according to 2-tailed *p* values, have been underlined.

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GL | | | | | | |
| *U. deningeri* | 1 | | 3.22 | 1.34 | 2.18 | 1.57 | 1.71 | 1.28 | 0.12 | 1.95 | 0.03 |
| *U. rossicus* | 2 | 2.63 | | 4.74 | 6.23 | 4.36 | 5.47 | 2.06 | 3.09 | 0.43 | 3.19 |
| *U. k. praekudarensis* | 3 | 2.32 | 3.88 | | 0.66 | 0.47 | 0.25 | 2.75 | 1.47 | 3.00 | 1.37 |
| *U. k. kudarensis* | 4 | 5.34 | 6.15 | 1.15 | | 0.02 | 0.45 | 3.92 | 2.33 | 3.67 | 2.22 |
| *U. s. spelaeus* | 5 | 1.48 | 3.19 | 0.66 | 1.97 | | 0.30 | 2.71 | 1.67 | 3.04 | 1.59 |
| *U. k. ingressus* | 6 | 4.05 | 5.26 | 0.25 | 1.35 | 1.08 | | 3.29 | 1.85 | 3.32 | 1.74 |
| *U. k. kanivetz* | 7 | 0.75 | 2.16 | 2.78 | 6.06 | 1.93 | 4.79 | | 1.15 | 1.06 | 1.25 |
| *U. s. eremus* | 8 | 1.36 | 3.33 | 1.15 | 3.03 | 0.39 | 1.92 | 1.95 | | 1.86 | 0.09 |
| *U. s. ladinicus* | 9 | 1.02 | 1.01 | 2.53 | 4.09 | 1.91 | 3.30 | 0.61 | 1.80 | | 1.93 |
| *U. arctos* | 10 | 0.80 | 3.01 | 1.65 | 3.91 | 0.86 | 2.73 | 1.45 | 0.56 | 1.45 | |
| | | | | | Bp | | | | | | |
| *U. deningeri* | 1 | | 3.10 | 0.68 | 2.67 | 1.10 | 0.63 | 0.58 | 0.03 | 1.41 | 2.09 |
| *U. rossicus* | 2 | 1.56 | | 3.92 | 6.51 | 1.24 | 3.44 | 3.75 | 3.07 | 0.38 | 0.93 |
| *U. k. praekudarensis* | 3 | 0.06 | 1.36 | | 2.00 | 1.63 | 0.04 | 0.09 | 0.71 | 1.81 | 2.84 |
| *U. k. kudarensis* | 4 | 5.18 | 4.16 | 3.15 | | 3.05 | 1.57 | 2.05 | 2.71 | 2.83 | 5.12 |
| *U. s. spelaeus* | 5 | 0.36 | 1.57 | 0.23 | 2.85 | | 1.53 | 1.55 | 1.08 | 0.51 | 0.51 |
| *U. k. ingressus* | 6 | 1.10 | 2.09 | 0.80 | 2.34 | 0.55 | | 0.12 | 0.66 | 1.75 | 2.52 |
| *U. k. kanivetz* | 7 | 0.65 | 1.90 | 0.34 | 4.75 | 0.04 | 0.69 | | 0.61 | 1.75 | 2.70 |
| *U. s. eremus* | 8 | 0.65 | 1.85 | 0.40 | 3.52 | 0.13 | 0.50 | 0.14 | | 1.40 | 2.06 |
| *U. s. ladinicus* | 9 | 1.15 | 0.44 | 0.98 | 4.09 | 1.20 | 1.77 | 1.53 | 1.49 | | 0.17 |
| *U. arctos* | 10 | 2.62 | 0.01 | 1.85 | 7.14 | 2.13 | 2.94 | 3.27 | 2.82 | 0.57 | |
| | | | | | Dp | | | | | | |
| *U. deningeri* | 1 | | 3.97 | 1.24 | 0.52 | 2.16 | 0.08 | 1.83 | 0.53 | 2.02 | 2.20 |
| *U. rossicus* | 2 | 1.51 | | 2.97 | 5.56 | 1.22 | 3.68 | 5.95 | 4.52 | 0.93 | 1.61 |
| *U. k. praekudarensis* | 3 | 0.35 | 1.03 | | 2.17 | 1.21 | 1.20 | 3.22 | 1.80 | 1.18 | 1.13 |
| *U. k. kudarensis* | 4 | 3.96 | 3.41 | 2.72 | | 2.95 | 0.35 | 1.78 | 0.15 | 2.61 | 3.20 |
| *U. s. spelaeus* | 5 | 1.15 | 0.49 | 0.62 | 3.52 | | 2.08 | 3.78 | 2.62 | 0.12 | 0.20 |
| *U. k. ingressus* | 6 | 0.44 | 1.02 | 0.05 | 2.99 | 0.60 | | 1.57 | 0.40 | 1.97 | 2.09 |
| *U. k. kanivetz* | 7 | 2.91 | 2.90 | 2.08 | 1.09 | 2.88 | 2.31 | | 1.29 | 3.42 | 4.03 |
| *U. s. eremus* | 8 | 1.01 | 0.83 | 0.38 | 4.09 | 0.34 | 0.35 | 3.27 | | 2.42 | 2.72 |
| *U. s. ladinicus* | 9 | 2.13 | 0.30 | 1.46 | 4.28 | 0.87 | 1.47 | 3.71 | 1.30 | | 0.30 |
| *U. arctos* | 10 | 2.38 | 0.02 | 1.37 | 5.35 | 0.66 | 1.39 | 4.57 | 1.21 | 0.36 | |
| | | | | | SD | | | | | | |
| *U. deningeri* | 1 | | 3.26 | 1.77 | 2.46 | 0.34 | 0.06 | 0.92 | 0.59 | 1.83 | 1.84 |
| *U. rossicus* | 2 | 2.17 | | 5.53 | 6.84 | 3.15 | 3.85 | 4.39 | 2.65 | 0.54 | 1.34 |
| *U. k. praekudarensis* | 3 | 0.36 | 2.11 | | 0.53 | 1.12 | 2.04 | 0.84 | 2.43 | 3.22 | 3.82 |
| *U. k. kudarensis* | 4 | 4.84 | 4.44 | 2.70 | | 1.58 | 3.02 | 1.44 | 3.19 | 3.72 | 4.77 |
| *U. s. spelaeus* | 5 | 0.46 | 1.51 | 0.64 | 3.29 | | 0.33 | 0.44 | 0.85 | 1.96 | 1.94 |
| *U. k. ingressus* | 6 | 0.86 | 2.56 | 0.22 | 3.60 | 0.97 | | 1.01 | 0.73 | 2.02 | 2.17 |
| *U. k. kanivetz* | 7 | 0.81 | 1.79 | 0.86 | 5.59 | 0.01 | 1.60 | | 1.54 | 2.56 | 2.85 |
| *U. s. eremus* | 8 | 1.16 | 1.36 | 1.15 | 4.84 | 0.38 | 1.78 | 0.54 | | 1.39 | 1.25 |
| *U. s. ladinicus* | 9 | 1.83 | 0.45 | 1.78 | 4.40 | 1.13 | 2.27 | 1.40 | 0.93 | | 0.44 |
| *U. arctos* | 10 | 3.45 | 0.23 | 2.72 | 7.43 | 1.81 | 3.97 | 2.75 | 1.77 | 0.34 | |
| | | | | | Bd | | | | | | |
| *U. deningeri* | 1 | | 3.11 | 1.60 | 1.76 | 0.12 | 0.84 | 3.08 | 0.15 | 1.51 | 2.18 |
| *U. rossicus* | 2 | 2.62 | | 5.01 | 5.74 | 2.79 | 4.47 | 6.49 | 3.26 | 0.53 | 0.83 |
| *U. k. praekudarensis* | 3 | 0.22 | 1.89 | | 0.07 | 1.24 | 0.93 | 1.62 | 1.44 | 2.60 | 3.92 |

| Taxa | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *U. k. kudarensis* | 4 | 3.35 | 4.73 | 2.45 | | 1.31 | 1.05 | 1.94 | 1.59 | 2.70 | 4.41 |
| *U. s. spelaeus* | 5 | 0.49 | 1.57 | 0.24 | 2.57 | | 0.57 | 2.51 | 0.01 | 1.49 | 2.01 |
| *U. k. ingressus* | 6 | 0.79 | 3.04 | 0.72 | 2.42 | 0.96 | | 2.65 | 0.68 | 2.12 | 3.32 |
| *U. k. kanivetz* | 7 | 5.06 | 5.77 | 3.38 | 1.15 | 3.43 | 3.86 | | 2.93 | 3.58 | 5.36 |
| *U. s. eremus* | 8 | 0.04 | 2.27 | 0.16 | 2.70 | 0.41 | 0.65 | 3.88 | | 1.61 | 2.33 |
| *U. s. ladinicus* | 9 | 1.53 | 0.57 | 1.12 | 3.39 | 0.87 | 1.93 | 4.20 | 1.37 | | 0.02 |
| *U. arctos* | 10 | 3.04 | 0.31 | 1.90 | 5.66 | 1.51 | 3.52 | 7.21 | 2.43 | 0.37 | |
| | | | | Dd | | | | | | | |
| *U. deningeri* | 1 | | 2.77 | 2.19 | 1.84 | 0.49 | 1.46 | 2.85 | 0.99 | 1.12 | 1.21 |
| *U. rossicus* | 2 | 1.67 | | 5.31 | 5.31 | 1.65 | 4.55 | 5.69 | 3.78 | 0.94 | 1.37 |
| *U. k. praekudarensis* | 3 | 0.53 | 1.79 | | 0.68 | 0.37 | 0.82 | 0.93 | 1.11 | 2.77 | 3.36 |
| *U. k. kudarensis* | 4 | 4.78 | 4.10 | 2.75 | | 0.16 | 0.26 | 1.62 | 0.64 | 2.51 | 3.13 |
| *U. s. spelaeus* | 5 | 1.06 | 2.08 | 0.51 | 1.78 | | 0.08 | 0.73 | 0.07 | 1.05 | 1.03 |
| *U. k. ingressus* | 6 | 1.94 | 2.62 | 0.81 | 2.56 | 0.12 | | 1.67 | 0.37 | 2.24 | 2.67 |
| *U. k. kanivetz* | 7 | 5.21 | 4.14 | 2.79 | 0.15 | 1.75 | 2.66 | | 1.87 | 3.28 | 3.90 |
| *U. s. eremus* | 8 | 0.63 | 1.91 | 0.01 | 3.27 | 0.57 | 0.98 | 3.39 | | 1.87 | 2.14 |
| *U. s. ladinicus* | 9 | 0.38 | 0.97 | 0.67 | 2.85 | 1.05 | 1.37 | 2.85 | 0.71 | | 0.15 |
| *U. arctos* | 10 | 1.74 | 0.51 | 1.75 | 5.34 | 2.08 | 3.12 | 5.60 | 1.99 | 0.67 | |

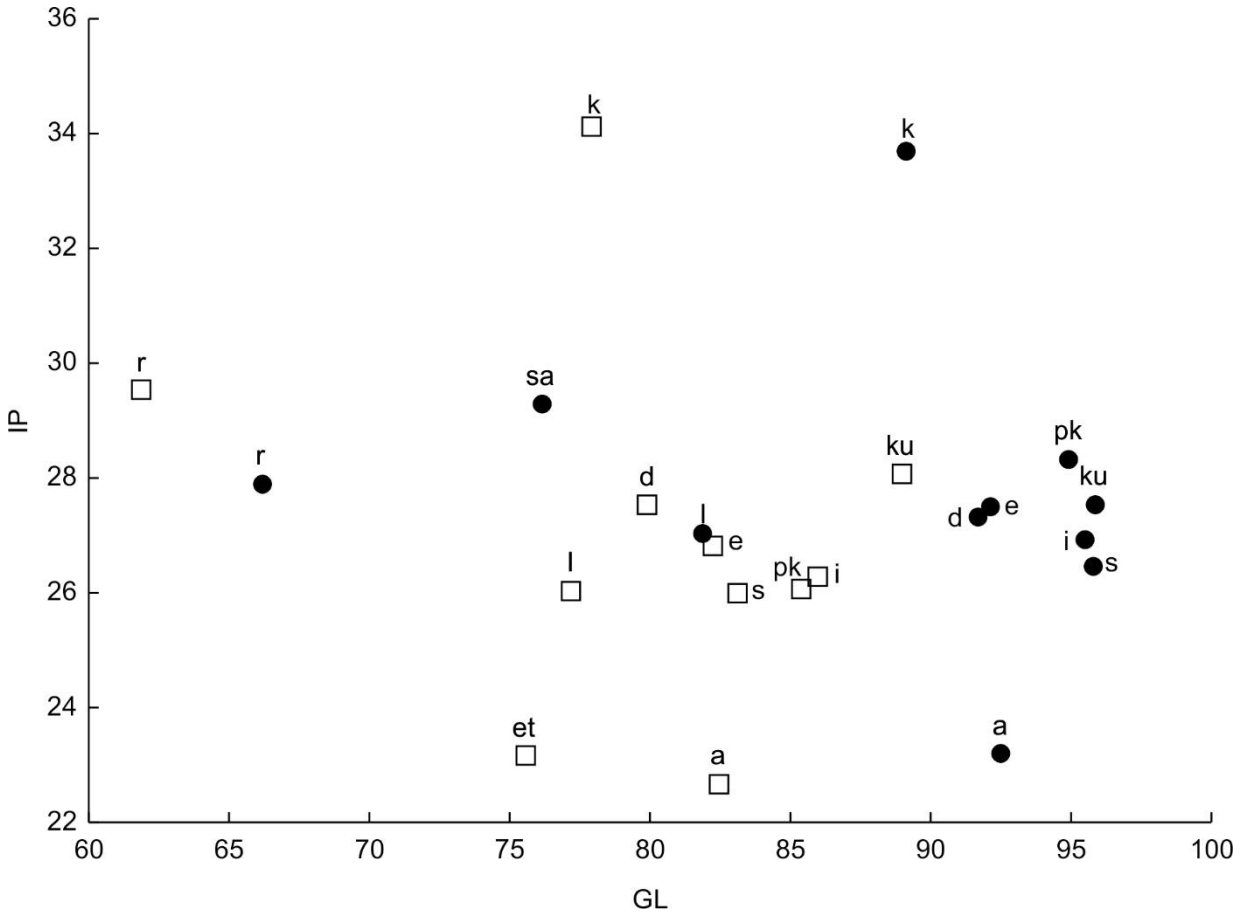


Fig. S22. The scatterplot of Index plumpness (ip) and GL of mtt V: et – *U. etruscus*, a – *U. arctos*, r – *U. rossicus*, d – *U. deningeri*, pk – *U. k. praekudarensis*, ku – *U. k. kudarensis*, s – *U. s. spelaeus*, k – *U. k. kanivetz*, i – *U. k. ingressus*, e – *U. s. eremus*, l – *U. s. ladinicus*. Point – males, square – females.

## Multivariate analyses

Table S33. Description of the modeled morphological spaces for cave bears and brown bear mtt V. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | |
| GL | 0.86 | 0.50 | 0.41 | 0.07 | 0.92 | 0.88 | 0.36 | 0.46 | -0.07 | 0.91 |
| Bp | 0.93 | 0.28 | 0.07 | 0.20 | 0.91 | 0.93 | 0.14 | 0.30 | 0.13 | 0.89 |
| Dp | 0.85 | -0.29 | -0.38 | -0.20 | 0.87 | 0.83 | -0.43 | -0.27 | 0.06 | 0.90 |
| SD | 0.90 | 0.33 | 0.06 | 0.32 | 0.91 | 0.91 | 0.20 | 0.36 | 0.20 | 0.87 |
| Bd | 0.89 | -0.17 | -0.17 | -0.21 | 0.86 | 0.87 | -0.31 | -0.09 | -0.26 | 0.86 |
| Dd | 0.90 | 0.03 | 0.09 | -0.29 | 0.90 | 0.89 | -0.12 | 0.10 | -0.38 | 0.91 |
| ip | 0.20 | -0.75 | -0.63 | -0.39 | | 0.16 | -0.78 | -0.63 | -0.31 | |
| Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 62.2 | 65.5 | 53.5 | 45.3 | | 64.7 | 59.2 | 51.8 | 45.2 | |

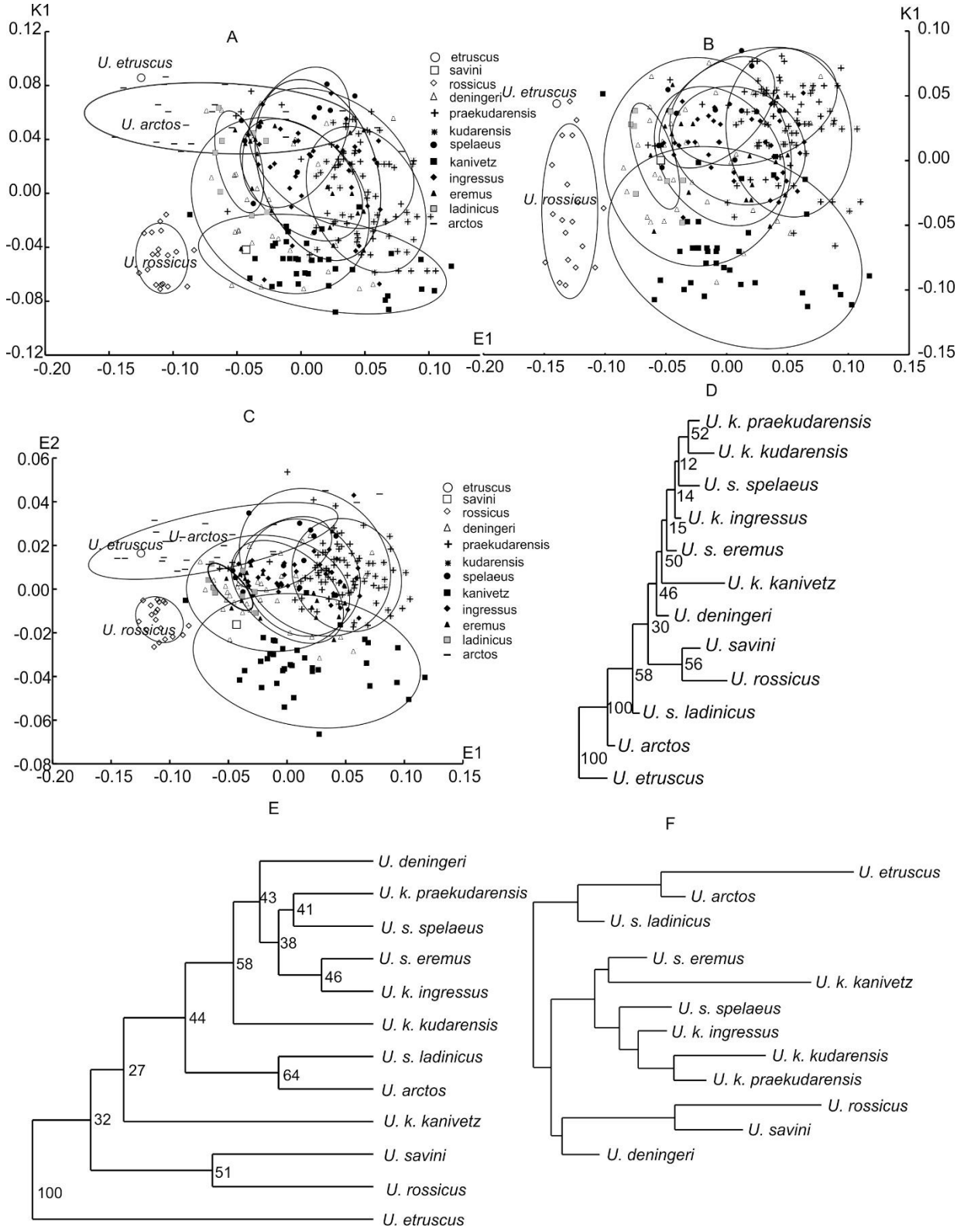


Fig. S23. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt V in males and females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.83); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Males

Table S34. Description of the modeled morphological spaces for males of cave bears and brown bear mtt V (males only). Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K2); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | Morphospaces without *U. arctos* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | | $r^2$ |
| | E1 | E2 | K1 | K2 | | E1 | E2 | K1 | K2 | K3 | |
| GL | 0.85 | 0.42 | 0.26 | 0.34 | 0.91 | 0.87 | 0.37 | 0.34 | 0.48 | 0.19 | 0.92 |
| Bp | 0.93 | 0.19 | -0.15 | 0.12 | 0.89 | 0.93 | 0.11 | 0.26 | 0.21 | 0.42 | 0.94 |
| Dp | 0.83 | -0.42 | -0.06 | -0.43 | 0.92 | 0.81 | -0.49 | -0.35 | 0.05 | 0.24 | 0.95 |
| SD | 0.89 | 0.32 | -0.28 | 0.21 | 0.92 | 0.89 | 0.21 | 0.36 | -0.02 | 0.10 | 0.93 |
| Bd | 0.91 | -0.06 | -0.06 | -0.12 | 0.84 | 0.91 | -0.16 | 0.00 | 0.09 | -0.06 | 0.90 |
| Dd | 0.91 | 0.07 | 0.19 | -0.04 | 0.89 | 0.91 | -0.01 | 0.06 | 0.43 | -0.01 | 0.92 |
| ip | 0.31 | -0.59 | -0.36 | -0.57 | | 0.26 | -0.66 | -0.42 | -0.43 | -0.36 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 83.3 | 48.7 | 41.3 | 41.7 | | 89.7 | 47.7 | 36.8 | 40.8 | 30.4 | |

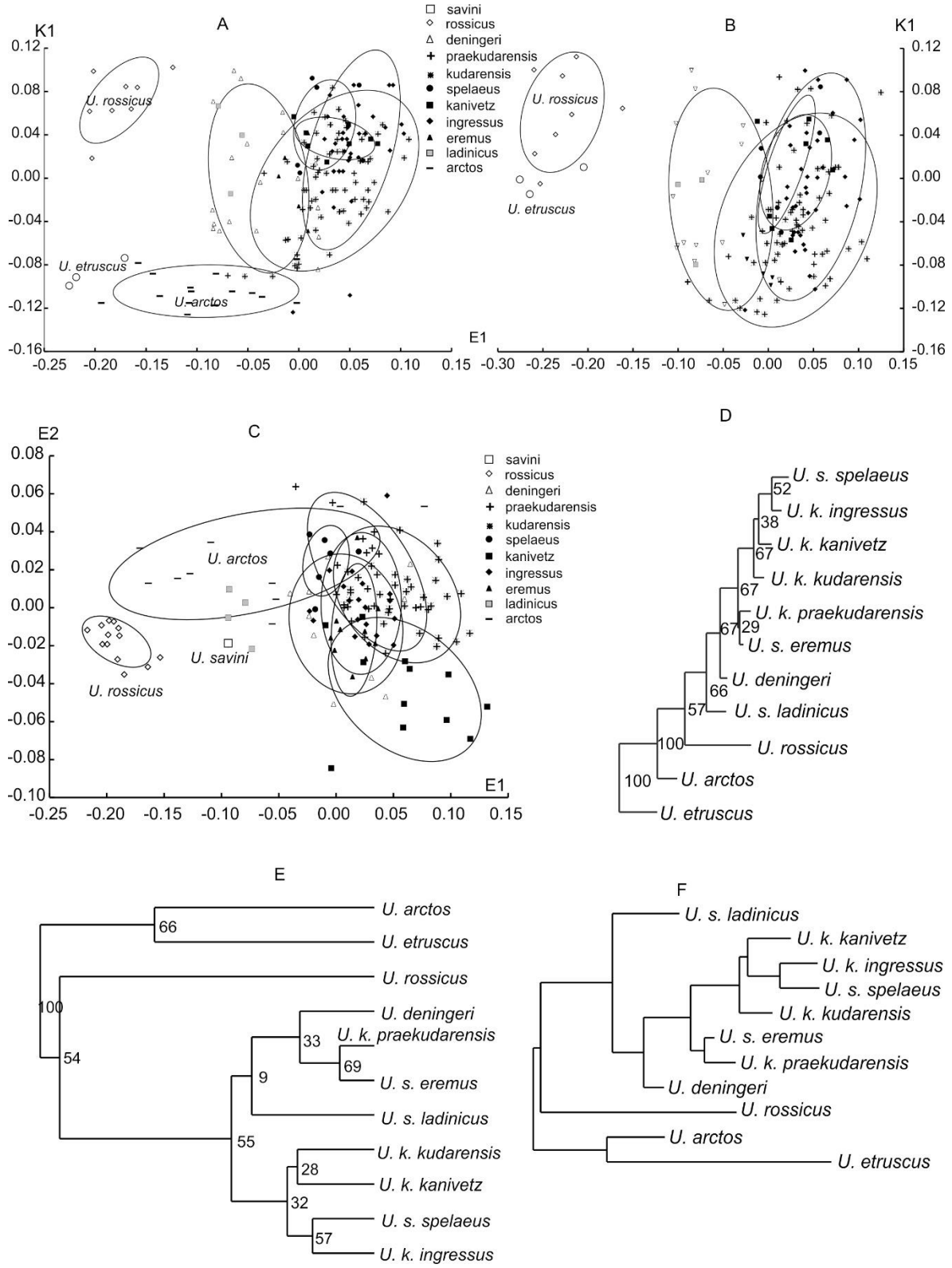


Fig. S24. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt V in males: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.89); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.

## Females

Table S35. Description of the modeled morphological spaces for females of cave bears and brown bear mtt V. Correlation coefficients among the measures and dimensions of two morphospace models (MDS axes: E1–E2, K1–K3); $r^2$ – coefficients of determination in the linear multiple regression models.

| Measures | Morphospaces with *U. arctos* | | | | | | Morphospaces without *U. arctos* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | "Size" morphospace | | "Shape" morphospace | | | $r^2$ | "Size" morphospace | | "Shape" morphospace | | $r^2$ |
| | E1 | E2 | K1 | K2 | K3 | | E1 | E2 | K1 | K2 | |
| GL | 0.63 | 0.58 | 0.19 | 0.43 | -0.06 | 0.88 | 0.72 | 0.48 | 0.52 | 0.18 | 0.86 |
| Bp | 0.84 | 0.41 | 0.27 | 0.03 | -0.40 | 0.94 | 0.87 | 0.20 | 0.33 | 0.06 | 0.85 |
| Dp | 0.78 | -0.36 | -0.42 | -0.48 | 0.00 | 0.94 | 0.73 | -0.50 | -0.41 | -0.07 | 0.88 |
| SD | 0.76 | 0.44 | 0.35 | -0.13 | -0.18 | 0.89 | 0.81 | 0.27 | 0.39 | -0.21 | 0.89 |
| Bd | 0.83 | -0.43 | -0.53 | -0.22 | -0.55 | 0.94 | 0.76 | -0.59 | -0.42 | 0.46 | 0.93 |
| Dd | 0.88 | -0.17 | -0.44 | 0.09 | -0.47 | 0.93 | 0.85 | -0.35 | -0.18 | 0.51 | 0.89 |
| ip | 0.43 | -0.79 | -0.65 | -0.48 | -0.49 | | 0.30 | -0.89 | -0.74 | 0.33 | |
| | Relative variance (%) of dimensions associated with taxonomical composition | | | | | | | | | | |
| | 74.6 | 77.2 | 60.8 | 50.4 | 33.2 | | 79.6 | 77.4 | 68.5 | 40.3 | |

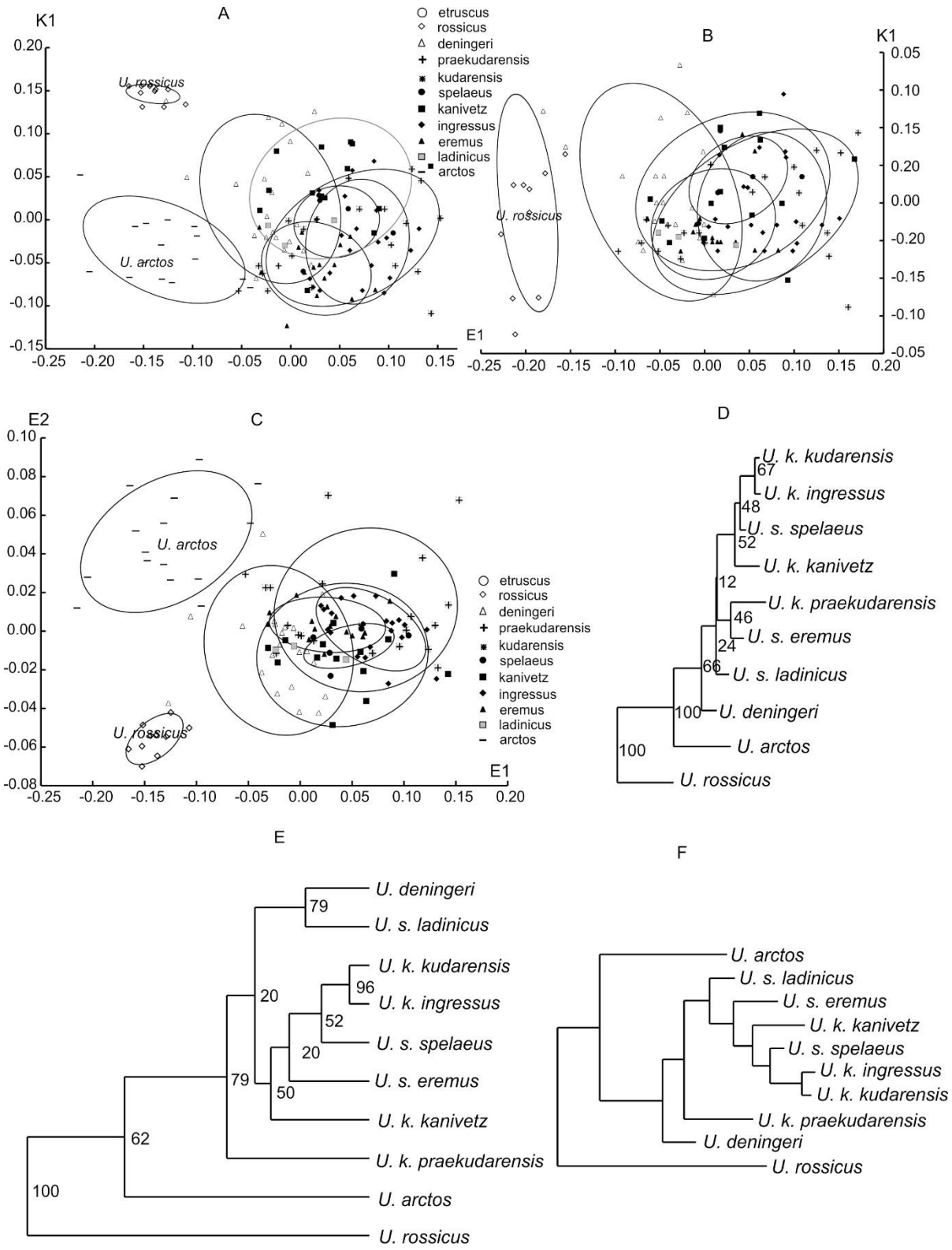


Fig. S25. Scatterplot of the first dimensions of "size" (E1) and "shape" (K1) morphospaces reproduced variation of mtt V in females: A, C – models with *U. arctos*; B – model without *U. arctos*; C – "size" morphospace; D – NJ tree; E – UGMA dendrogram (cophenetic correlation – 0.95); F – Sattath-Tversky (Sattath, Tversky, 1977) additive tree. All classifications based on the coordinates of samples' centroids in the "size" (E1, E2) and "shape" (K1, K2) morphospaces (numbers near the nodes - bootstrap (1000 repeats) supports in %). Ellipses' horizontal and vertical projection onto the E1 (E2) and K1 axes are equal to the "sample mean" (centroid) ± "sample range" x 0.95.