

Cave bear remains from the Buco dell'Orso Cave (Lombardy - Italy). Part III – Morphometric analysis of metapodial bones

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Abstract

Metapodial remains of *Ursus spelaeus* ROSENMÜLLER-HEINROTH, 1784 from Buco dell'Orso Cave (Laglio, Lombardy, Northern Italy) are morphologically and morphometrically presented. In several cases the relationship between parameters indicates a sexual distinction. Further, the biometrical analysis has shown that the remains, even if having speloid characteristics, have a size similar to *U. deningeri* VON REICHENAU, 1904 and smaller than the typical *U. spelaeus*. This is the same conclusion shown by the cranial, the mandibular and the limb bones, and suggests to a more ancient age for the Buco dell'Orso remains than for the typical, larger *U. spelaeus*.

Key words: *Ursus spelaeus*, metapodi, morphometric analysis, Upper Pleistocene

Résumé

Les restes de métapodes d'*U. spelaeus* ROSENMÜLLER-HEINROTH, 1784 provenant de la grotte de Buco dell'Orso (Laglio, Lombardie, Italie du Nord) sont analysés morphologiquement et morphométriquement. Dans plusieurs cas, les relations entre les paramètres indiquent une distinction sexuelle. De plus, l'analyse biométrique a montré que ces fossiles, bien qu'ayant des caractères spéloïdes, ont une taille semblable à celle d'*U. deningeri* VON REICHENAU, 1904 et donc inférieure à celle d'*U. spelaeus* typique. Ceci concorde avec la conclusion tirée de l'étude des crânes, des mandibules et des os longs et suggère que les fossiles de la grotte de Buco dell'Orso sont plus anciens que les restes d'*U. spelaeus* typique dont la taille est supérieure.

Mots-clés: *Ursus spelaeus*, métapodes, analyse morphométrique, Pleistocène supérieur

Introduction

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784 remains from the Buco dell'Orso Cave, near Laglio (Como Province, north of Milano in Lombardy), have been known for a long time, but only in the last years has a sharper morphometrical analysis of the different parts of the skeleton been effected. Cranial and mandibular remains

were examined by SANTI & ROSSI (2001) (a morphogenetic analysis of the P4 – RABEDER (1999) - is not yet effected for a small number of the teeth) and the bones of the anterior and rear limbs by ROSSI & SANTI (2001 a). Together with the bear fossils, the new discoveries of *Myotis (Selysius) bechsteini* (LEISLER in KUHL, 1818) (SANTI, 2000) and *Panthera (Leo) spelaea* (GOLDFUSS, 1810) (ARDUINI *et al.*, 2002) seem to indicate a Würmian age and a greater biodiversity than previously known. This note has the aim to continue the morpho-osteological and morphometrical examination of the metapodial bones, the autopodia parts that are generally very rarely considered in the studies about bears.

Short review of the geological characteristics of the fossiliferous locality and previous work about the limbs of cave bears

The Buco dell'Orso Cave (Fig. 1A-B) is located near the village of Laglio and opens at 648 m. It represents a typical karst phenomenon, together with the "dolina-sink" observable to the north of the cave. It is placed on calcareous-micritic deposits of the Lower-Middle Lias and is about 300 m long, while its maximum height is 15 m. It presents an ENE-WSW direction passing to WNW-ESE; the cave is crossed by numerous fractures forming different families with NNW-SSE direction, that often determine or have determined how the large blocks fall.

AIRAGHI (1858-71) effected the only, not detailed stratigraphic series of the Buco dell'Orso Cave individualising six levels of which only the second (starting from the base) is rich in fossil bones. Afterwards the cave was closed.

Briefly, starting at the base: a) Stalagmitic layer covering one of shale, b) Yellow shale with a few calcareous fragments and iron oxides, c) Brown shale, d) Very pure shale, e) Stalagmitic crust evenly widened, f) Sand and calcareous fragments.

The studies which consider bear remains as very important elements are very abundant; so it is hard to list them all. We refer again to the studies of SANTI & ROSSI

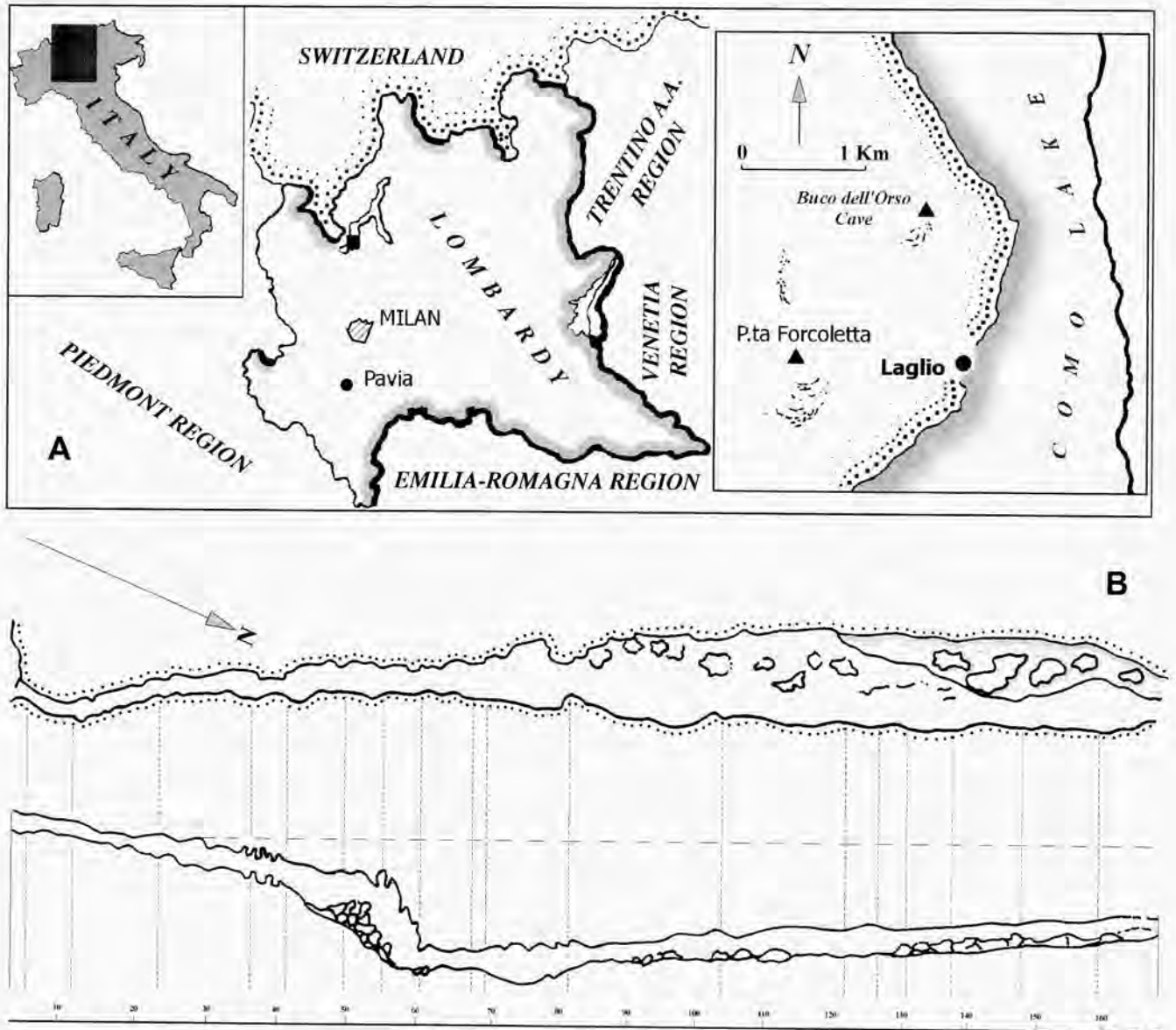


Fig. 1 — **A** - Geographical position of the Buco dell'Orso Cave, **B** - map and transversal section of the cave (after CORNALIA, 1858-71).

(2001) and ROSSI & SANTI (2001 a) for a deeper review. We only list the more recent works that have emphasised the *Ursus* limb and metapodial remains. Besides the already cited studies, morphometric analyses of the limbs have recently been presented by CUGGANI (1981), TORRES (1988), KUNST (1992), GRANDAL D'ANGLADE (1993), RUSTICHELLI (1993) and by REISINGER & HOHENEGGER (1998) who proposed a sexual dimorphism hypothesis based on biometrical characters. Later BARYSHNIKOV & DAVID (2000) measured the metapodial bones of *Ursus* coming from the Arcy-sur-Cure Caves (Yonne, France) without advancing any comparison hypotheses. Within a broader study of the Upper Pleistocene mammals from the Grosse Grotte (Blaubeuren, SW Germany)

based on metapodial remains, WEINSTOCK (1999) offered a short morphometric analysis on some metacarpi and metatarsi bones of *Ursus spelaeus*, comparing them with those discovered in the Sybillenhöhle. A short analysis on the metapodial evolution of the cave bear group based on fossils from caves of Italy and Austria was effected by GERHARD (2001), who advanced some biostratigraphic implications, while the metapodial fossils from Western Croatia were the object of research by GUZVICA & RADANOVIC-GUZVICA (2000). Finally, DI CANZIO & PETRONIO (2001) signaled the presence of fossils of this anatomical part of *Ursus spelaeus* from Cola Cave (L'Aquila, Abruzzo Region, Central Italy), presenting again a short morphometrical analysis.

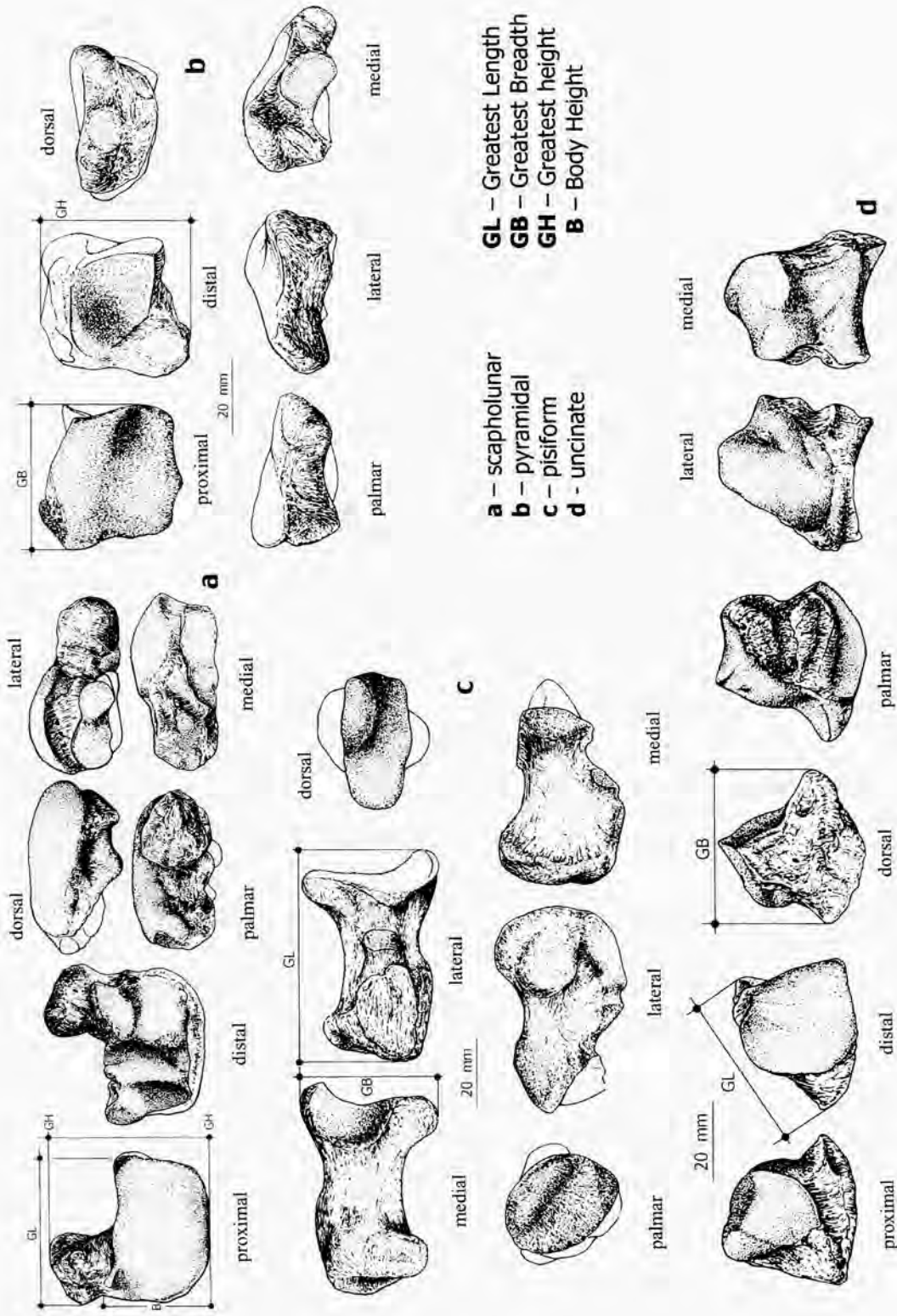


Fig. 2 — Dimensional parameters of the carpal bones of the *Ursus spelaeus* (after VON DRIESCH, 1988).

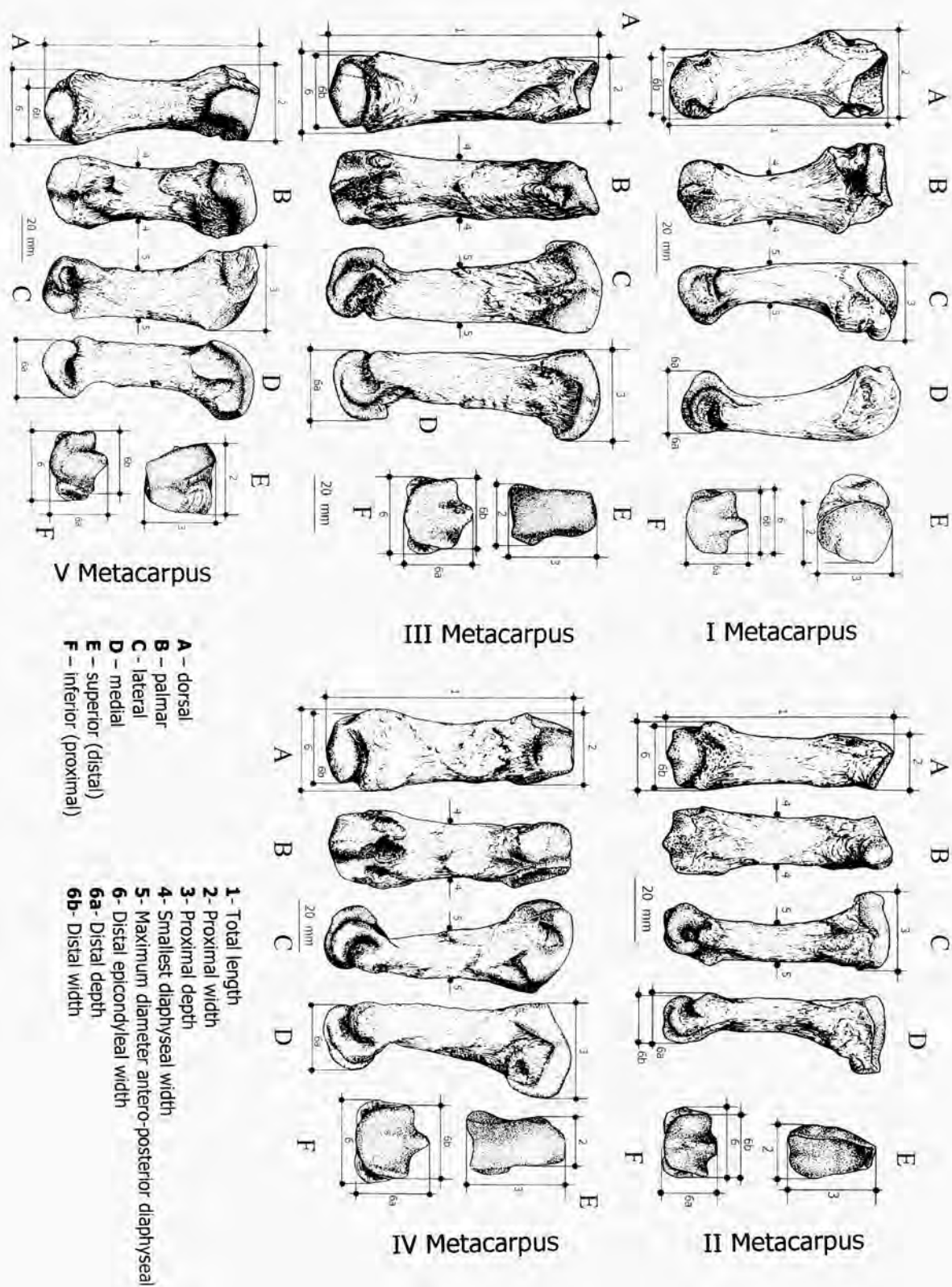
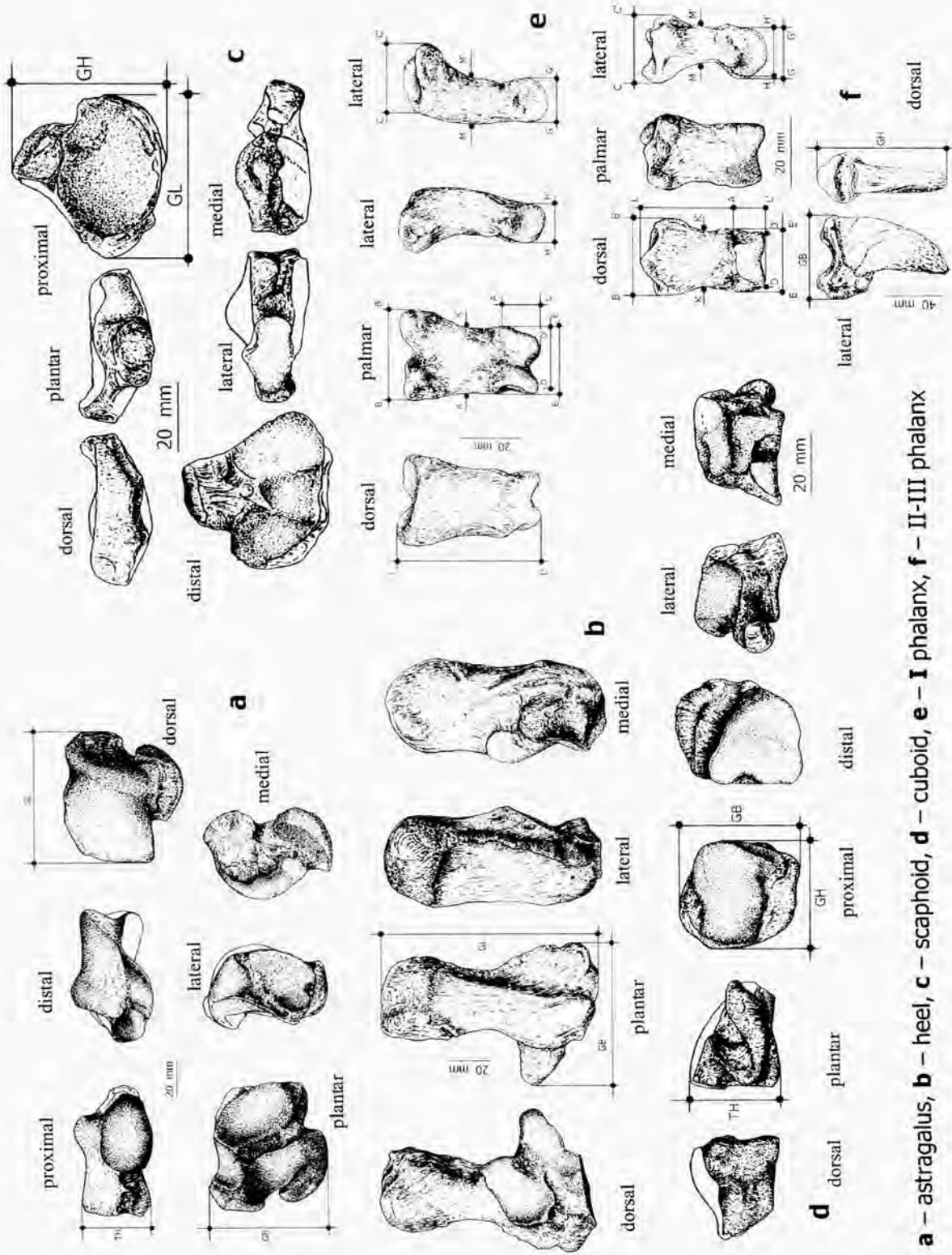


Fig. 3 — Dimensional parameters of the metacarpus bones of the *Ursus spelaeus* (after VON DRUESCH, 1976; GERHARD, 2001).



a – astragalus, **b** – heel, **c** – scaphoid, **d** – cuboid, **e** – I phalanx, **f** – II-III phalanx

Fig. 4 — Dimensional parameters of the tarsal bones and phalanx of the *Ursus spelaeus* (after HUE, 1907; VON DRIESCH, 1976). Explanation of the abbreviations: **GL**: greatest length, **GB**: greatest breadth, **GH**: greatest height, **TH**: thickness, phalanx: **LL**: greatest length, **AL**: height of the trochlea, **BB**: diameter transversal of the superior extremity, **CC**: diameter antero-posterior of the superior extremity, **DD**: diameter transversal of the trochlea, **EE**: diameter transversal of the inferior extremity, **GG**: diameter antero-posterior of the internal condyle, **HH**: diameter antero-posterior of the external condyle, **KK**: diameter transversal of the diaphysis, **MM**: diameter antero-posterior of the diaphysis.

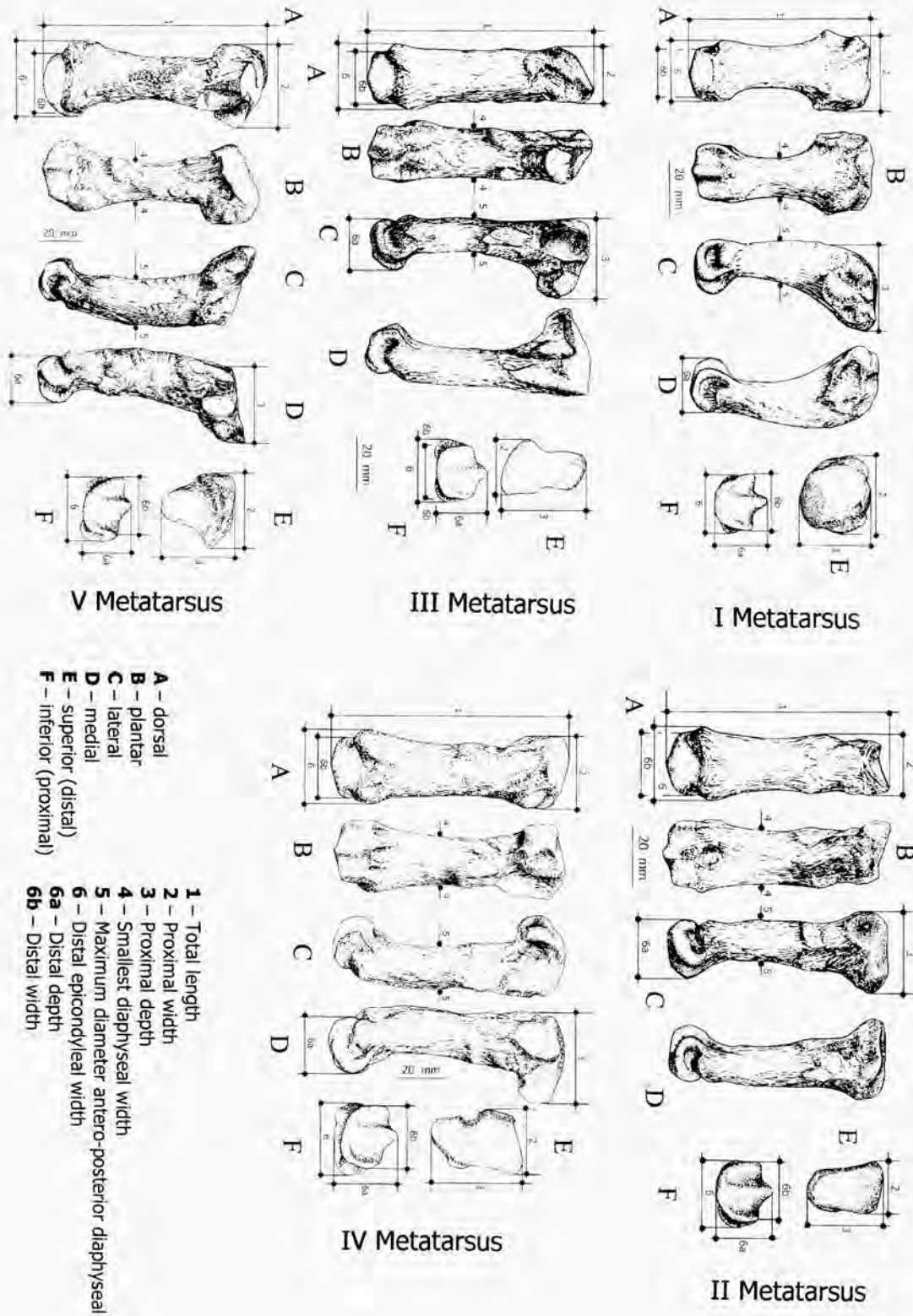


Fig. 5 — Dimensional parameters of the metatarsus bones of the *Ursus spelaeus* (after VON DRIESCH, 1976; GERIARD, 2001).

Materials and methods

The fossiliferous material here analyzed consists of 340 specimens now kept in the Museo Civico di Storia Naturale in Milano (Plates 1-7). Their preservation is generally good, and only a small number of the fossils are incomplete or worn particularly in the proximal and distal ends. We have seen no pathologic or marks of human action, so it seems unnecessary to offer a detailed description of the remains. A series of measurements utilising the codified parameters of HUE (1907), VON DRIESCH (1976) and TORRES (1988) has been taken (Figs 2-5).

Fossils are ascribed to *Ursus spelaeus* ROSENMÜLLER-HEINROTH, 1784. The morphological characteristics of this bear are often present, but a few specimens do not always clearly present the typical characteristics of the cave bear, and may suggest *U. deningeri* VON REICHENAU, 1904. However, we have considered these remains as *U. spelaeus* on the base of the broader morphological relationships with this species.

SANTI & ROSSI (2001) on canines of the cranial and mandibular bones individualised males and females.

Discussion

Studies based on the morphometric analysis of the metapodial bones are not very frequent, so in the literature data are few. Briefly the studies by TORRES (1988), WEINSTOCK (1999) and DI CANZIO & PETRONIO (2001) are considered as main references for this discussion. In order to reach a best understanding we have divided the comments for the single bones starting with those of the hand. In general, Table 1 shows that the smaller size of the *U. spelaeus* from Buco dell'Orso Cave compared with the remains (*U. spelaeus*, *U. deningeri* and *U. arctos*) of the Spanish caves is clear. In some cases the size of the metacarpi and metatarsi fossils are close to *U. deningeri*; so, in general, the *U. spelaeus* from Buco dell'Orso is not a bear with the classic size shown by the typical *spelaeus* forms, as the skulls, the mandibular and the limbs remains have shown (SANTI & ROSSI, 2001; ROSSI & SANTI, 2001 a). An "index of plumpness" comparison between the metacarpi and metatarsi remains with those of the other localities (Withalm, *pers. com.*) has shown that the Buco dell'Orso metacarpi fossils are very similar to those from other countries. A difference is reported for the metatarsi. Slight variations are observed between the Buco dell'Orso metatarsi and the Spanish caves, and in comparison with the Withalm data those of the Laglio Cave are more slender. We think that this is an expression of the particular phylogenetic position occupied by the Buco dell'Orso bears (ROSSI & SANTI, 2001 b).

Pisiform, scapholunar, uncinat – A first consideration from observing the diagrams of the Figs 6a-b is advanced. These show a comparison between the *U. spelaeus* pisiform from Delle Fate Cave (near Finale Ligure, Liguria, Northern Italy) and the ones from the Buco dell'Orso Cave; the latter fall in the dispersion

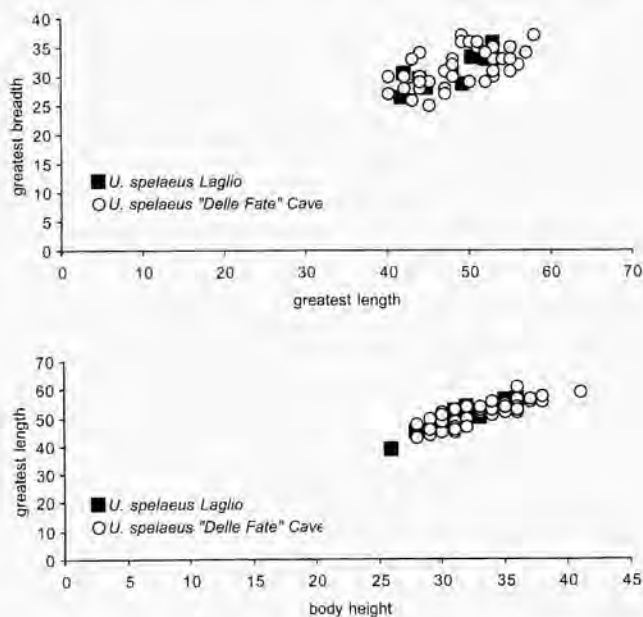


Fig. 6 — a) **Pisiform**: comparison between *U. spelaeus* remains from Buco dell'Orso and Delle Fate Caves. b) **Scapholunar**: comparison between *U. spelaeus* remains from Buco dell'Orso and Delle Fate Caves. (after RUSTICHELLI, 1991 unpublished). Measurements in mm.

cloud of the points of the Delle Fate Cave as for the scapholunar fossils. This is important because we have confirmation that the Laglio pisiform specimens are *U. spelaeus*. Fig. 7, which puts in relation the *Greatest length* with the *Greatest breadth*, shows a broad dispersion of the representative points of every specimen. Except for three points that fall in the typical *deningeri*-

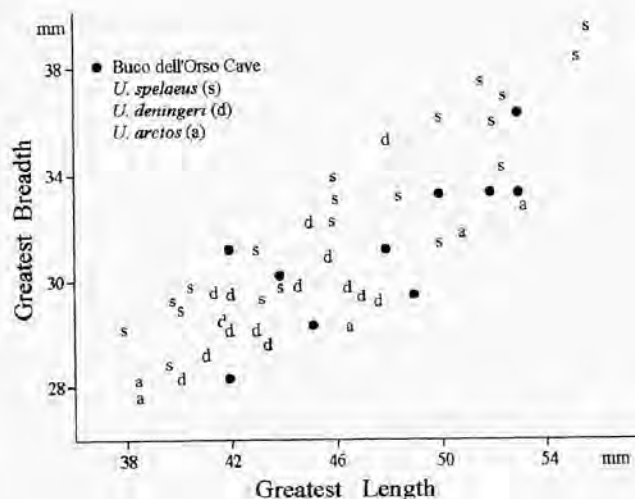


Fig. 7 — **Pisiform**: comparison between *U. spelaeus*, *U. deningeri* and *U. arctos* remains from Buco dell'Orso and Spanish caves (after TORRES, 1988).

I Metacarpus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|-----------|
| N = 21 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 59,24 | 5,88 | 45,7-68,2 |
| 2 | 23,47 | 2,54 | 19,2-29,6 |
| 3 | 19,71 | 2,61 | 13-24,7 |
| 4 | 12,69 | 1,78 | 9,3-15,4 |
| 5 | 12,07 | 2,1 | 9-16,1 |
| 6 | 17,95 | 1,76 | 14,6-21,3 |
| 2\1 | 39,58 | 3,13 | 33,6-44,9 |
| 4\1 | 21,44 | 2,25 | 17,5-25,4 |
| 6\1 | 30,37 | 2,15 | 23,9-34,4 |

II Metacarpus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|------------|
| N = 25 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 66,12 | 3,47 | 59,5-71,5 |
| 2 | 15,5 | 1,31 | 13,5-19 |
| 3 | 23,64 | 2,47 | 18,5-28 |
| 4 | 13,84 | 1,45 | 11-16,4 |
| 5 | 10,64 | 1,22 | 8,5-12,6 |
| 6 | 19,99 | 2,48 | 12,65-23,4 |
| 2\1 | 23,4 | 1,25 | 21,7-26,6 |
| 4\1 | 21,11 | 1,58 | 16,8-23,7 |
| 6\1 | 30,18 | 2,9 | 27,6-33,5 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 60,6 | 5,16 | 48,3-69,8 |
| 2 | 24,3 | 1,9 | 19,6-29,8 |
| 3 | 21,6 | 2,34 | 14,6-31,2 |
| 4 | 13,4 | 1,26 | 9,8-15,5 |
| 5 | 12,4 | 1,37 | 9,2-16,5 |
| 6 | 19,4 | 1,9 | 14,7-23,7 |
| 2\1 | 40 | | 36-47 |
| 4\1 | 22 | | 17-28 |
| 6\1 | 31 | | 25-34 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 73,4 | 5,01 | 63,7-87,5 |
| 2 | 17,7 | 1,82 | 13,9-32 |
| 3 | 27,3 | 2,93 | 21,2-34 |
| 4 | 17,5 | 1,75 | 14,2-21,8 |
| 5 | 13,9 | 1,86 | 10,1-21,6 |
| 6 | 23,9 | 2,27 | 18,3-30,9 |
| 2\1 | 25 | | 21-30 |
| 4\1 | 24 | | 19-30 |
| 6\1 | 33 | | 24-42 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 59,4 | 3,51 | 52,4-64,7 |
| 2 | 21,9 | 1,4 | 18,6-24,2 |
| 3 | 18,6 | 1,69 | 15,3-22,8 |
| 4 | 10,8 | 1,23 | 9,3-13,7 |
| 5 | 10,5 | 0,49 | 9,6-11,1 |
| 6 | 16,1 | 1,03 | 14,4-18 |
| 2\1 | 37 | | 34-42 |
| 4\1 | 18 | | 17-25 |
| 6\1 | 27 | | 24-32 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 72,1 | 2,89 | 67-77,2 |
| 2 | 16,8 | 1,21 | 14,7-19,5 |
| 3 | 24,7 | 2,72 | 23,5-28 |
| 4 | 14,9 | 1,13 | 13,2-17 |
| 5 | 13,5 | 1,52 | 11,5-16,6 |
| 6 | 22,1 | 1,52 | 19,4-24,7 |
| 2\1 | 18,6 | 1,45 | 16-20,7 |
| 4\1 | 20 | | 60-75 |
| 6\1 | 31 | | 27-33 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 69,5 | 5,89 | 55-82,8 |
| 2 | 22,5 | 3,08 | 18,5-27,6 |
| 3 | 19,5 | 2,53 | 16,5-24,8 |
| 4 | 10,9 | 1,53 | 9-13,2 |
| 5 | 10,7 | 1,55 | 8,8-13,7 |
| 6 | 17,5 | 1,8 | 14,6-20,3 |
| 2\1 | 32,3 | 3,2 | 28-35 |
| 4\1 | 15,4 | 1,67 | 13-19 |
| 6\1 | 25,1 | 1,75 | 23-30 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 77,8 | 7,63 | 62,2-89,9 |
| 2 | 16,8 | 2,48 | 11,7-19,7 |
| 3 | 23,8 | 3,1 | 19,6-28,7 |
| 4 | 13 | 1,65 | 10,2-15,1 |
| 5 | 12,5 | 2,17 | 9,5-16,4 |
| 6 | 19,6 | 2,68 | 16-23,3 |
| 2\1 | 20,1 | 2,17 | 17-24 |
| 4\1 | 16,6 | 1,3 | 15-19 |
| 6\1 | 25,7 | 2,82 | 20-33 |

Tab. 1 — Means, standard deviation, minimum and Maximum values for the parameters and index referring to the *U. spelaeus*, *U. deningeri* and *U. arctos* remains from Buco dell'Orso Cave and from Spanish caves.

III Metacarpus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|-------------|
| N = 24 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 74,78 | 5,57 | 68,7-87,25 |
| 2 | 18,37 | 2,04 | 14,5-22,4 |
| 3 | 26,87 | 3,29 | 23-34,8 |
| 4 | 15,63 | 1,19 | 13,5-18,2 |
| 5 | 13,27 | 1,54 | 11,25-16,55 |
| 6 | 23,44 | 1,84 | 21,65-28,4 |
| 2\1 | 24,27 | 1,93 | 20,1-27,9 |
| 4\1 | 29,08 | 5,57 | 19,5-22,3 |
| 6\1 | 31,35 | 1,27 | 29,2-33,7 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 78,1 | 4,73 | 66-91,1 |
| 2 | 20,4 | 2,11 | 16-25,6 |
| 3 | 28,8 | 3,13 | 21,6-36,6 |
| 4 | 17,3 | 1,84 | 12,5-21 |
| 5 | 14,2 | 1,71 | 11-22,1 |
| 6 | 25,3 | 2,17 | 19,5-30,2 |
| 2\1 | 26 | | 19-34 |
| 4\1 | 22,5 | | 18-28 |
| 6\1 | 39 | | 25-37 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 75 | 3,27 | 67,2-80,2 |
| 2 | 17,7 | 1,3 | 15,4-20,7 |
| 3 | 26,7 | 1,34 | 24,6-28,6 |
| 4 | 14,1 | 0,81 | 12,7-15,5 |
| 5 | 12,5 | 0,68 | 11,5-13,5 |
| 6 | 22 | 1,42 | 19,4-24,8 |
| 2\1 | 24 | | 22-27 |
| 4\1 | 19 | | 17-21 |
| 6\1 | 29 | | 26-31 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 78 | 5,83 | 63,4-86,3 |
| 2 | 17 | 1,67 | 12,5-20 |
| 3 | 24,1 | 2,79 | 19-29,6 |
| 4 | 12,8 | 1,45 | 10,1-15,2 |
| 5 | 11,5 | 1,7 | 8,6-13,9 |
| 6 | 19,9 | 2,26 | 16,2-23 |
| 2\1 | 22 | 1,92 | 19-26 |
| 4\1 | 16,5 | 1,27 | 14-19 |
| 6\1 | 25,7 | 2,27 | 22-30 |

IV Metacarpus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|------------|
| N = 28 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 80,83 | 5,92 | 70,4-89,2 |
| 2 | 21,28 | 1,93 | 17-23,55 |
| 3 | 30,56 | 3,97 | 21,2-36,45 |
| 4 | 17,64 | 1,89 | 14,2-21,1 |
| 5 | 15,53 | 2,23 | 12,8-20,4 |
| 6 | 25,01 | 2,74 | 17-29,45 |
| 2\1 | 26,51 | 1,68 | 24,1-30,5 |
| 4\1 | 22,06 | 1,37 | 19,6-24,3 |
| 6\1 | 30,93 | 3,16 | 19,3-36,8 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 81,2 | 5,1 | 64,7-96 |
| 2 | 23,8 | 1,99 | 15,8-28,8 |
| 3 | 31,4 | 3,01 | 23,6-38 |
| 4 | 18,9 | 1,71 | 15,2-21,8 |
| 5 | 17,8 | 1,58 | 12,5-20,2 |
| 6 | 26,6 | 2,03 | 22,3-34,5 |
| 2\1 | 28 | | 22-34 |
| 4\1 | 23 | | 19-27 |
| 6\1 | 33 | | 26-40 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 73,9 | 3,56 | 67,2-80,6 |
| 2 | 18,6 | 0,86 | 17,3-20,3 |
| 3 | 26,8 | 2,03 | 20,7-29,6 |
| 4 | 14,4 | 0,93 | 11,8-15,4 |
| 5 | 13,4 | 1,05 | 11,8-16 |
| 6 | 22,7 | 1,29 | 20,1-25 |
| 2\1 | 25 | | 24-28 |
| 4\1 | 19 | | 17-21 |
| 6\1 | 31 | | 28-32 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 80,5 | 6,47 | 67-93,6 |
| 2 | 17,8 | 2,08 | 14,8-21 |
| 3 | 24 | 3,6 | 21,2-29,6 |
| 4 | 13,2 | 2,08 | 11,1-17,8 |
| 5 | 11,1 | 1,76 | 9-13,7 |
| 6 | 19,8 | 2,37 | 17,5-24,5 |
| 2\1 | 22,1 | 1,39 | 20-25 |
| 4\1 | 16,5 | 1,55 | 15-20 |
| 6\1 | 24,5 | 1,73 | 22-28 |

V Metacarpus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|------------|
| N = 25 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 79,45 | 16,9 | 67,7-87,8 |
| 2 | 28,44 | 6,09 | 25,15-32,6 |
| 3 | 22,24 | 6,36 | 25,4-38,4 |
| 4 | 17,74 | 3,51 | 14-22 |
| 5 | 15,78 | 2,83 | 12,6-19 |
| 6 | 26,42 | 5,04 | 19,5-31,3 |
| 2\1 | 35,71 | 2,39 | 31,8-44,1 |
| 4\1 | 22,02 | 1,68 | 18,7-25,3 |
| 6\1 | 33,14 | 1,69 | 28,8-37,1 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 81,4 | 5,76 | 65,8-94,6 |
| 2 | 28,9 | 3,43 | 21,4-35,3 |
| 3 | 32,4 | 3,6 | 19,7-39,7 |
| 4 | 19,7 | 2,71 | 14,4-24,7 |
| 5 | 18,4 | 2,14 | 11,2-25,1 |
| 6 | 28 | 2,6 | 20,6-36,2 |
| 2\1 | 36 | | 32-42 |
| 4\1 | 24 | | 18-28 |
| 6\1 | 35 | | 27-40 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 76,3 | 3,43 | 71,2-80 |
| 2 | 26,2 | 2,35 | 22,4-30,5 |
| 3 | 28,8 | 3,18 | 26,8-39,2 |
| 4 | 15,3 | 1,34 | 13,4-18,1 |
| 5 | 13,5 | 1,12 | 11,0-16 |
| 6 | 25,1 | 2,72 | 22,6-29 |
| 2\1 | 34 | | 32-39 |
| 4\1 | 20 | | 18-23 |
| 6\1 | 33 | | 30-39 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 80 | 7,89 | 60,8-95,2 |
| 2 | 23,1 | 3,5 | 17,4-28,8 |
| 3 | 26 | 3,49 | 20-31,8 |
| 4 | 14,3 | 1,9 | 11,6-17,6 |
| 5 | 12,1 | 2,02 | 9,3-16 |
| 6 | 21,5 | 2,56 | 16-25,1 |
| 2\1 | 27,2 | 2,14 | 26-33 |
| 4\1 | 17,8 | 1,65 | 15-20 |
| 6\1 | 26,9 | 1,62 | 24-30 |

I Metatarsus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|-----------|
| N = 11 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 42,78 | 15,82 | 48-62,55 |
| 2 | 24,3 | 7,44 | 19,7-26 |
| 3 | 23,13 | 7,03 | 22-28,9 |
| 4 | 11,52 | 2,96 | 9,5-15,4 |
| 5 | 12,7 | 2,74 | 10,5-15,1 |
| 6 | 16,45 | 3,95 | 12,0-20 |
| 2\1 | 43,39 | 3,28 | 38,3-48,2 |
| 4\1 | 22,35 | 3,06 | 17,6-27,1 |
| 6\1 | 31,81 | 3,19 | 24,8-36,5 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 56,4 | 4,59 | 46,7-67 |
| 2 | 23,3 | 2,52 | 17-29,2 |
| 3 | 22,6 | 2,26 | 14,3-29,2 |
| 4 | 12,6 | 1,32 | 9,3-16,1 |
| 5 | 12,6 | 1,34 | 9-15,8 |
| 6 | 17,8 | 1,51 | 13,5-21,8 |
| 2\1 | 41 | | 35-49 |
| 4\1 | 22 | | 15-27 |
| 6\1 | 31 | | 23-41 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 54,1 | 3,54 | 48,7-62 |
| 2 | 21,5 | 2,34 | 18,7-25,8 |
| 3 | 19,6 | 2,94 | 13,4-26,3 |
| 4 | 10 | 1,35 | 8,7-13,3 |
| 5 | 11,2 | 1,43 | 9,2-14,3 |
| 6 | 15,3 | 1,37 | 13,6-17,2 |
| 2\1 | 40 | | 35-46 |
| 4\1 | 18 | | 16-22 |
| 6\1 | 28 | | 25-31 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 66,9 | 6,96 | 51-76,7 |
| 2 | 21,9 | 2,92 | 16,3-26,2 |
| 3 | 21,3 | 2,58 | 16,1-25,5 |
| 4 | 10,9 | 1,31 | 9-13,1 |
| 5 | 11,6 | 1,89 | 8,3-15,1 |
| 6 | 17,3 | 2,03 | 14,5-21,1 |
| 2\1 | 32,6 | 1,91 | 29-37 |
| 4\1 | 16,2 | 1,11 | 14-18 |
| 6\1 | 25,8 | 2,3 | 22-30 |

II Metatarsus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|------------|
| N = 13 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 62,36 | 21,48 | 65-82,5 |
| 2 | 20,08 | 5,75 | 16-24,2 |
| 3 | 24,19 | 7,09 | 21,35-31,2 |
| 4 | 14,51 | 4,61 | 13,75-20 |
| 5 | 13,47 | 4,46 | 11,3-25 |
| 6 | 20,81 | 6,72 | 20,2-30,3 |
| 2\1 | 31,09 | 10,01 | 24,2-31,2 |
| 4\1 | 21,9 | 4,9 | 20,5-24,5 |
| 6\1 | 31,29 | 7,18 | 30,6-36,1 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 66,7 | 3,12 | 58,5-77 |
| 2 | 15,5 | 1,05 | 12,7-19,7 |
| 3 | 24,3 | 1,92 | 20-29,4 |
| 4 | 14,6 | 1,29 | 12-17,3 |
| 5 | 11,2 | 1,08 | 8,7-13,7 |
| 6 | 21 | 1,54 | 17,3-24,8 |
| 2\1 | 23 | | 21-31 |
| 4\1 | 22 | | 18-26 |
| 6\1 | 31 | | 28-37 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 64,1 | 2,66 | 59,3-66,9 |
| 2 | 14,5 | 1,02 | 13-16,7 |
| 3 | 23,1 | 1,31 | 20-25,7 |
| 4 | 12,6 | 1,25 | 10,3-15,3 |
| 5 | 10 | 0,65 | 9,0-11 |
| 6 | 18,8 | 1,24 | 16,3-20,6 |
| 2\1 | 22 | | 21-25 |
| 4\1 | 19 | | 17-21 |
| 6\1 | 29 | | 27-31 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 73,3 | 7,8 | 57,4-88,6 |
| 2 | 13,8 | 2,46 | 10-18,5 |
| 3 | 23,5 | 3,29 | 19,7-30 |
| 4 | 12,6 | 1,65 | 10-14,7 |
| 5 | 9,9 | 1,65 | 7,7-13,4 |
| 6 | 18,6 | 2,35 | 15,2-21,6 |
| 2\1 | 18,5 | 1,99 | 15-21 |
| 4\1 | 16,8 | 1,09 | 15-19 |
| 6\1 | 25,3 | 2,15 | 23-30 |

III Metatarsus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|-------------|
| N = 18 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 69,45 | 19,76 | 67-81 |
| 2 | 16,45 | 4,53 | 14-21,6 |
| 3 | 26,72 | 9,9 | 27-36,45 |
| 4 | 14,41 | 3,46 | 13-17,2 |
| 5 | 12,42 | 2,67 | 11,85-14,65 |
| 6 | 20,64 | 4,99 | 19-25,7 |
| 2\1 | 22,71 | 4 | 19,5-27,4 |
| 4\1 | 19,61 | 3,53 | 17,9-22,1 |
| 6\1 | 27,92 | 5,16 | 26,3-32,6 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 76,3 | 4,43 | 64-91,9 |
| 2 | 19,1 | 2,31 | 14,3-28 |
| 3 | 29,4 | 2,76 | 24,8-35 |
| 4 | 16 | 1,5 | 11,8-19,8 |
| 5 | 12,8 | 1,36 | 9,5-15,5 |
| 6 | 22 | 1,69 | 16,8-25,5 |
| 2\1 | 25 | | 21-31 |
| 4\1 | 21 | | 16-24 |
| 6\1 | 30 | | 26-33 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 71,5 | 4,01 | 67-80,2 |
| 2 | 16,7 | 1,36 | 14,3-18,3 |
| 3 | 26,1 | 1,85 | 22-28,6 |
| 4 | 13,1 | 1,01 | 10-14,6 |
| 5 | 11,2 | 0,75 | 10-13,4 |
| 6 | 19,5 | 1,71 | 18-21,4 |
| 2\1 | 24 | | 21-27 |
| 4\1 | 19 | | 16-21 |
| 6\1 | 27 | | 22-29 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 78,5 | 6,5 | 62,4-89,6 |
| 2 | 16,6 | 2,52 | 11,2-20,8 |
| 3 | 26,3 | 3,36 | 20,9-31-1 |
| 4 | 12,8 | 1,49 | 10,8-14,8 |
| 5 | 11,2 | 1,94 | 8,1-14,7 |
| 6 | 18,8 | 2,22 | 15,6-23 |
| 2\1 | 20,9 | 1,67 | 18-25 |
| 4\1 | 16,1 | 0,92 | 15-18 |
| 6\1 | 23,9 | 1,95 | 21-27 |

IV Metatarsus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|-------------|
| N = 26 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 77.87 | 23.39 | 74,7-91,25 |
| 2 | 17.73 | 3,9 | 12,25-22,2 |
| 3 | 30.5 | 6,61 | 24,85-37,4 |
| 4 | 14,62 | 2,69 | 10,4-17,05 |
| 5 | 13,72 | 3,62 | 9,55-16,8 |
| 6 | 22,12 | 4,68 | 15,15-26,05 |
| 2\1 | 22,01 | 1,34 | 19,7-24,7 |
| 4\1 | 18,2 | 1,44 | 15,7-22,8 |
| 6\1 | 27,57 | 1,69 | 22-30 |

V Metatarsus

| <i>U. spelaeus</i> (Buco dell'Orso) | | | |
|-------------------------------------|-------|----------|-------------|
| N = 21 | | | |
| Parameters | m | st. dev. | m-M |
| 1 | 79.45 | 19,01 | 71,85-97,45 |
| 2 | 26,23 | 6,24 | 23,6-34,45 |
| 3 | 27,09 | 6,12 | 24,85-33,15 |
| 4 | 12,15 | 3,45 | 10,85-15,7 |
| 5 | 14,85 | 2,61 | 13,05-18,25 |
| 6 | 22,64 | 4,27 | 20,05-27,25 |
| 2\1 | 32,96 | 2,6 | 27,9-38,1 |
| 4\1 | 15,74 | 1,19 | 12,8-17,7 |
| 6\1 | 28,25 | 1,66 | 25,7-33 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 83,6 | 5 | 71,8-97,7 |
| 2 | 21,4 | 1,86 | 16,3-25 |
| 3 | 30,1 | 2,66 | 25,1-37,3 |
| 4 | 17 | 1,5 | 13,1-20,2 |
| 5 | 14,8 | 1,49 | 10,9-18,1 |
| 6 | 22,4 | 2,03 | 19,5-31 |
| 2\1 | 25 | | 21-29 |
| 4\1 | 20 | | 17-23 |
| 6\1 | 29 | | 26-32 |

U. spelaeus (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|------------|
| 1 | 83,9 | 5,69 | 71,7-104,2 |
| 2 | 28,9 | 3,19 | 21,7-42 |
| 3 | 29,7 | 3,45 | 22,7-37,2 |
| 4 | 14,8 | 1,36 | 12,2-18,6 |
| 5 | 15,8 | 1,43 | 12-19,3 |
| 6 | 24,7 | 1,98 | 19,8-30,2 |
| 2\1 | 34 | | 30-43 |
| 4\1 | 18 | | 14-20 |
| 6\1 | 29 | | 20-38 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 77 | 2,55 | 72,5-81,4 |
| 2 | 19,7 | 1,89 | 17,7-23 |
| 3 | 27,4 | 2,11 | 19,4-31 |
| 4 | 14,4 | 1,4 | dic-18 |
| 5 | 12,2 | 0,95 | 10,9-14,2 |
| 6 | 20,9 | 1,37 | 18,8-22,5 |
| 2\1 | 25 | | 22-26 |
| 4\1 | 18 | | 16-20 |
| 6\1 | 27 | | 25-30 |

U. deningeri (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 79,9 | 5,9 | 70,1-84 |
| 2 | 24,1 | 4,01 | 21-30,4 |
| 3 | 27 | 2,3 | 24,3-31,6 |
| 4 | 12,3 | 1,26 | 10,6-15,3 |
| 5 | 12,5 | 0,95 | 10,8-14,1 |
| 6 | 20,7 | 3,14 | 18,4-23,4 |
| 2\1 | 29 | | 20-36 |
| 4\1 | 15 | | 13-17 |
| 6\1 | 26 | | 23-29 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 88.5 | 6,62 | 71,2-96,8 |
| 2 | 19,9 | 2,16 | 14,4-22,7 |
| 3 | 27 | 3,66 | 20,8-37,2 |
| 4 | 13,8 | 1,57 | 10,4-15,7 |
| 5 | 12,7 | 1,82 | 9,8-16,1 |
| 6 | 20,2 | 1,73 | 15,8-22,4 |
| 2\1 | 22,6 | 1,54 | 20-25 |
| 4\1 | 15,8 | 1,01 | 14-17 |
| 6\1 | 22,9 | 1,41 | 19-25 |

U. arctos (Spanish Caves)

| Parameters | m | st. dev. | m-M |
|------------|------|----------|-----------|
| 1 | 86,5 | 8,03 | 74-102,2 |
| 2 | 24,3 | 4,12 | 16-29,7 |
| 3 | 26,8 | 3,71 | 20,7-33,5 |
| 4 | 12,6 | 1,33 | 10,4-15,2 |
| 5 | 12 | 1,64 | 9,6-14,8 |
| 6 | 20,9 | 2,29 | 18,3-23,7 |
| 2\1 | 28,2 | 3,43 | 21-34 |
| 4\1 | 14,3 | 1,49 | 13-18 |
| 6\1 | 26 | 1,71 | 22-27 |

arctos field, the others fall in the *U. spelaeus* cloud. Two observations can be made: a) Buco dell'Orso's specimens, compared with the ones of the Spanish caves, are smaller, as the uncinat specimens (not in diagram) show, b) remains that fall in the *deningeri-arctos* field could be females and/or juvenile forms because all the fossils clearly present a *spelaeus* morphology. If this is correct, then the parameters can be utilized for a sexual distinction.

II metacarpus – Fig. 8, which shows the *Greatest length* and the *Smallest diaphyseal width*, establishes a comparison between *U. spelaeus* and *U. arctos* remains coming from different Italian localities. The Buco dell'Orso fossils clearly belong to *U. spelaeus*, in fact the typical points distribution results are clearly linked to the *spelaeus* trend. In this diagram two fields (*spelaeus* and *arctos*) are clearly evidenced, and the Buco dell'Orso fossils, with the same *spelaeus* dimensional trend, fall in a lowest position in this distribution of the cave bear cloud. This seems a confirmation of the results noted for the remains belonging to the different parts of the skeleton (skulls and mandibles, SANTI & ROSSI, 2001, pisiform see before). Further, in the DI CANZIO & PETRONIO (2001) study the fossil coming from Cola Cave is a female; some fossils from the Buco dell'Orso occupy a lowest position in comparison to that specimen. If we consider the useful dimensional boundary for a sexual distinction positioned close to the representative point of the Cola Cave specimen, we can suppose that fossils, whose points fall around the one of the Cola Cave, belong to females.

Alternately if the dimensional boundary males/females is positioned in the "empty" area (more probable) about in the middle in the dispersion cloud, then all the Buco dell'Orso specimens are females with cubs. In fact, the presence of cubs in the Buco dell'Orso Cave was surely demonstrated by SANTI & ROSSI (2001). A last consideration is advanced for the *U. spelaeus* point that falls in the

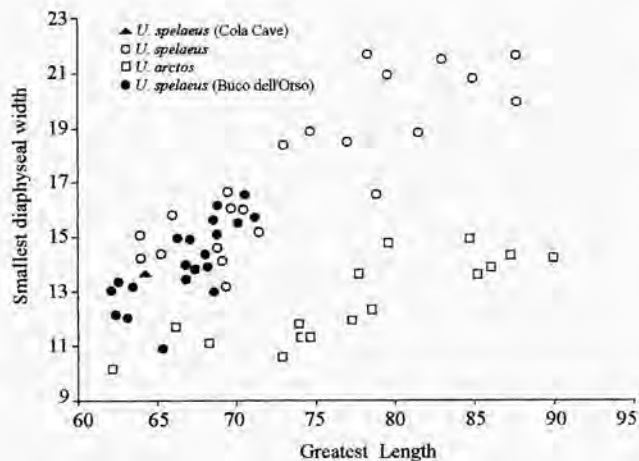


Fig. 8 — **II metacarpus**: comparison between *U. spelaeus*, *U. arctos* remains from Buco dell'Orso, Cola Caves and from different localities (after DI CANZIO & PETRONIO, 2001). Measurements in mm.

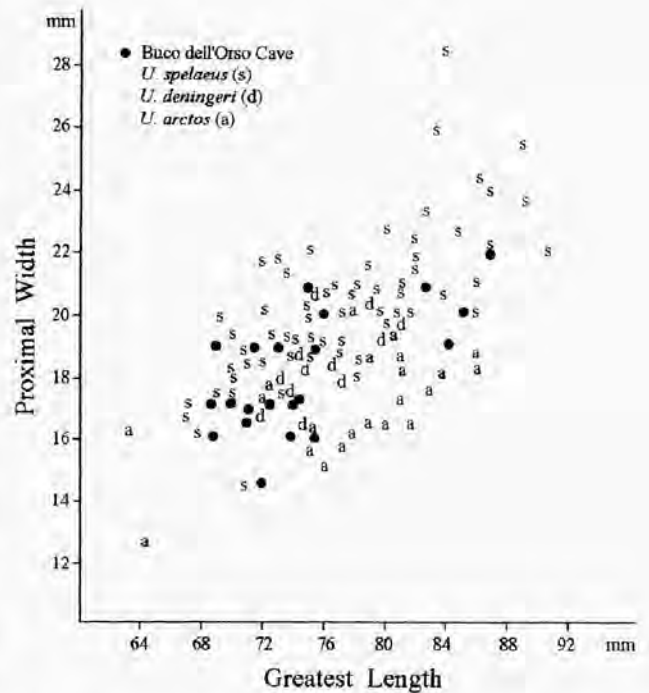


Fig. 9 — **III metacarpus**: comparison between *U. spelaeus*, *U. deningeri* and *U. arctos* remains from Buco dell'Orso and Spanish Caves (after TORRES, 1988).

arctos field; for its relative dimensional measures it is possible to consider it a juvenile form, probably a female.

III metacarpus – Fig. 9, which relates the *Greatest length* to the *Proximal width*, provides the following observations. In comparison with the *U. spelaeus* specimens from the Spanish caves, the ones from the Buco dell'Orso have a broad dimensional variability and only rarely do the points fall in the typical *spelaeus* position. In fact, many of the points fall in the lower area of the dispersion cloud of the *spelaeus* fossils; this can be linked to some Buco dell'Orso specimens that were small sized. Nevertheless the poor subdivision of the fields drawn by the *U. spelaeus* and *U. deningeri* remains is clearly evident; the typical *U. arctos* is well divided by the other ones. We want to emphasize that the dimension "means" of *U. spelaeus* and *U. deningeri* for the III metacarpus are similar and that the Buco dell'Orso specimens also fall in this distribution with the exception of few remains dimensionally close to the classic *U. spelaeus*. The confused subdivision of the *Ursus* fields cannot be linked to the parameters that have been put in relation, but to the fact that there is a small dimensional difference for these anatomical parts between the different species. It is hard to comment upon the sexual difference or to distinguish the bear species only utilizing the morphometrical base; in the III metacarpus case the morphology should play a fundamental role. But upon this point some hypotheses can be advanced; probably it is possible to draw a horizontal boundary placed around 18 mm for the *Proximal width*. Points that are localized below this boundary can

be considered the females and the ones further below the juvenile specimens, while probably the males are the ones arranged upon the boundary. The limited dimensional difference between *U. spelaeus* and *U. deningeri* is clear, as the dimensional separation is not evident for some anatomical parts, but there is rather a progressive passage in the distinctive characteristics that improves the assignment to one species or to the other. Withalm, evaluating the "index of plumpness" for the II and III metacarpal bones found a 3rd metacarpal predominance respect to the II. This is unusual because normally in the cave bear group we have the predominance of the II metacarpal bone. This could be an artefact linked to the low number of fossils (*pers. com.*).

IV metacarpus – A sharp observation of Fig. 10, based on the relation between the *Smallest diaphyseal*

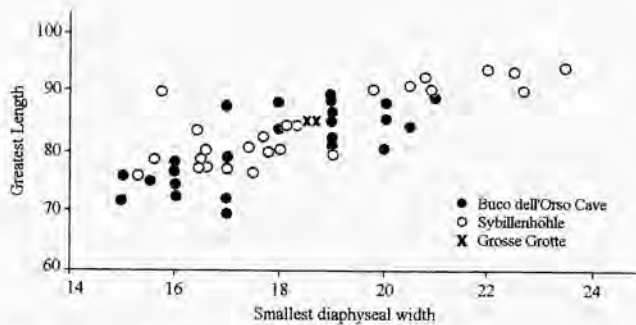


Fig. 10 — **IV metacarpus**: comparison between *U. spelaeus* remains from Buco dell'Orso and German Caves (after WEINSTOCK, 1999). Measurements in mm.

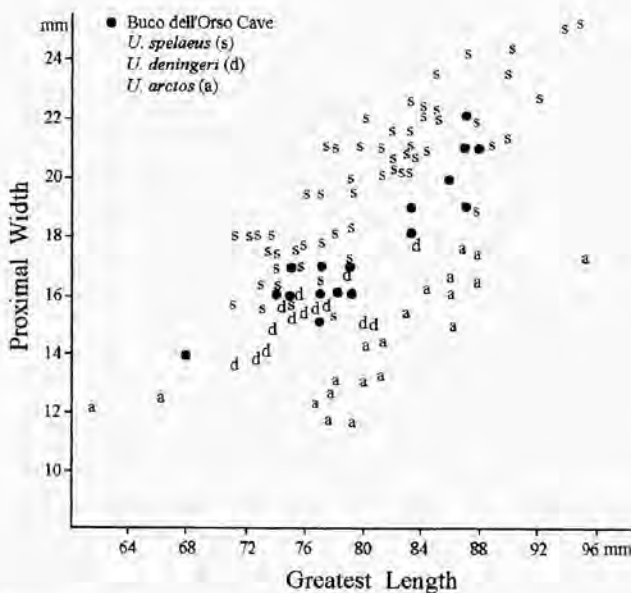


Fig. 11 — **V metacarpus**: comparison between *U. spelaeus*, *U. deningeri* and *U. arctos* remains from Buco dell'Orso and Spanish Caves (after TORRES, 1988).

width and the *Greatest length*, and the comparison with the Sibyllenhöhle and the Grosse Grotte (Germany) remains, allows us to advance this comment. The representative points of the Grosse Grotte fossils fall in a position that WEINSTOCK (1999) considers typical of the females. The distribution of the Buco dell'Orso fossils is very broad and this reflects the great variability shown by the IV metacarpus, but with drawing a hypothetical boundary around 19 mm for the *Smallest diaphyseal width*, it seems possible to distinguish the two sexes. If the great fields for the females and the males are clear, the sex of the fossils that fall in an intermediate position (the ones focalized around 19 mm in *Smallest diaphyseal width*), is difficult to define. Secondly, despite the fact that the Buco dell'Orso specimens follow the dimensional trend of the German ones, in different remains the small size in comparison to the typical *spelaeus* form is confirmed (particularly for the males).

V metacarpus – In contrast with the other graphs, Fig. 11, which puts in relation the *Greatest length* and the *Proximal width* of the *spelaeus*, *deningeri* and the *arctos* groups, shows a clear subdivision. The general trend given by the Buco dell'Orso remains is similar to the one of the Spanish *spelaeus* fossils, but they fall in a lower position in the dispersion cloud. Also in this case a good separation in two distinct groups, that could also define a sexual distinction between the males and females specimens, seems clear.

Astragalus, scaphoid – As often considered commenting on other diagrams, referring to these anatomical parts in the *spelaeus* field the clear subdivision between the Delle Fate Cave fossils and Buco dell'Orso ones (Fig. 12) is evident. In contrast, the few scaphoid fossils fall in the trend of the *U. spelaeus* from Delle Fate Cave but are located in the lower part of this dispersion (Fig. 13). In both cases the Buco dell'Orso fossils are smaller in size not relatively to absolute length, but frailer. If there are no doubts on the *U. spelaeus* identity and the smaller size of the Buco dell'Orso fossils, it remains to be seen if this separation should link to sexual differences or if they should be considered juvenile forms. The trend shown by the Buco dell'Orso remains is different from the one of

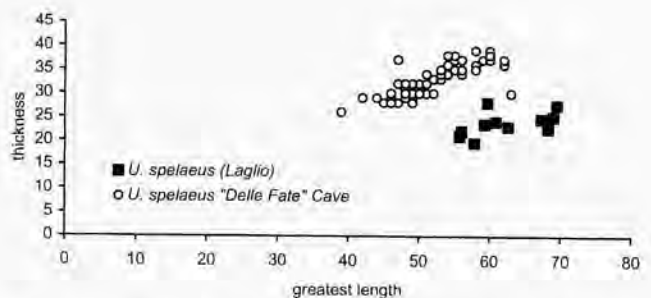


Fig. 12 — **Astragalus**: comparison between *U. spelaeus* remains from Buco dell'Orso and Delle Fate Caves (after RUSTICHELLI, 1991, unpublished).

the Delle Fate Cave. In particular the *Greatest length* is close to the one of the Delle Fate astragalus, but the thickness is lowest so the specimens are more squashed. Is this a condition of the females, or is it a condition shown only by the Buco dell'Orso remains? The absence

of data does not permit the choice between the first or second point.

I metatarsus – In Fig. 14 the Buco dell'Orso points are located in a broad distribution following the *U. spelaeus* trend; in fact the *U. arctos* cloud is clearly separated from the first. It is the opinion of DI CANZIO & PETRONIO (2001) that the Cola fossil is probably a female; at least three Buco dell'Orso specimens fall below the Cola point so they should surely be female forms.

III metatarsus – Fig. 15 is very interesting. WEINSTOCK (1999) considers the Grosse Grotte specimen as a probable small male; the distribution of the points of the Buco dell'Orso fossils follows the *U. spelaeus* German trend. The greater part is related to specimens with smaller size in comparison to the "probable small male" of WEINSTOCK. This confirms, like other cases for other anatomical parts, that the Buco dell'Orso remains are smaller in comparison with typical *U. spelaeus*. We note another aspect: at least three specimens have a smaller size and it is possible, or better very probable, that they are the females or cubs. The presence of cubs can be considered established if the greater part of the remains should be ascribed to smaller males, with their points positioned in the left part with respect to the Grosse Grotte one. The length of the Buco dell'Orso remains is aligned with the German ones, but they are mostly squashed as in the case of the astragalus (see above).

V metatarsus (Fig. 16) – About half of the Buco dell'Orso fossils fall in the typical Spanish *U. spelaeus* field, but they are small like the other anatomical parts. The other half is positioned in an area where we have together the remains of three species. Those with *spelaeus* morphology are smaller in comparison with other ones, so the hypothesis of the female presence among these fossils could be considered valid, while the presence of the juvenile forms does not have to be eliminated a priori.

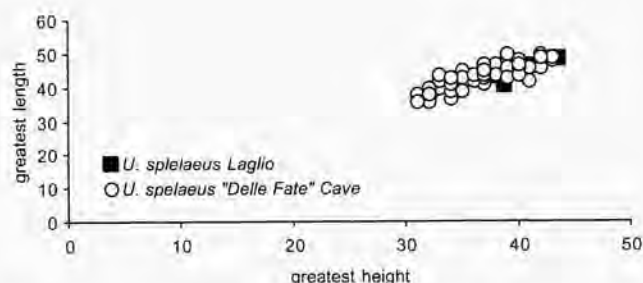


Fig. 13 — **Scaphoid** – comparison between *U. spelaeus* remains from Buco dell'Orso and Delle Fate Caves (after RUSTICHELLI, 1991, unpublished).

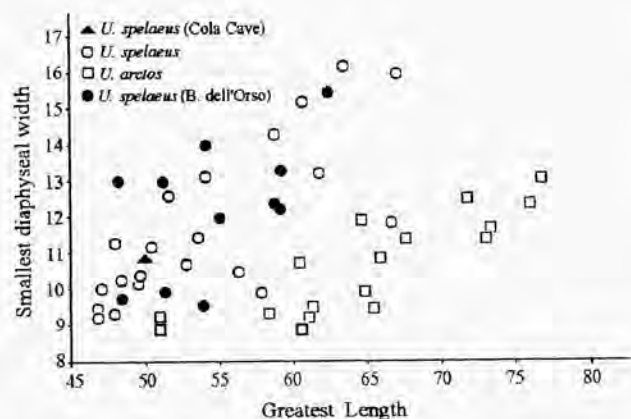


Fig. 14 — **I metatarsus**: comparison between *U. spelaeus*, *U. arctos* remains from Buco dell'Orso, Cola Caves and from different localities (after DI CANZIO & PETRONIO, 2001). Measurements in mm.

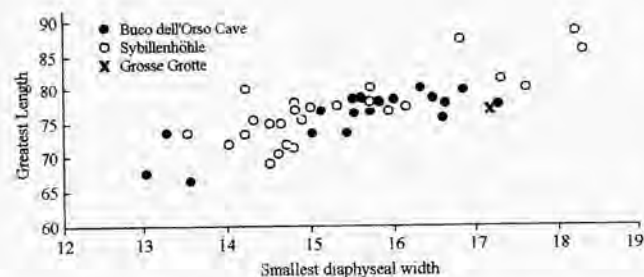


Fig. 15 — **III metatarsus**: comparison between *U. spelaeus* remains from Buco dell'Orso and German Caves (after WEINSTOCK, 1999). Measurements in mm.

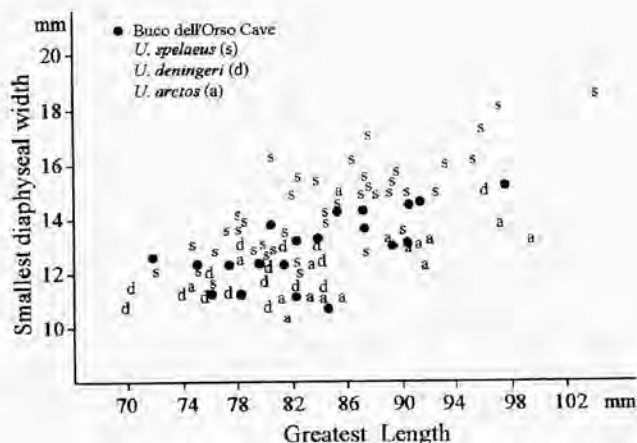


Fig. 16 — **V metatarsus**: comparison between *U. spelaeus*, *U. deningeri* and *U. arctos* remains from Buco dell'Orso and Spanish Caves (after TORRES, 1988).

Conclusions

With this study the trilogy related to the morphological and morphometric analysis on the Buco dell'Orso (Laglio, Como) bear fossils is closed. The first part was based on the cranial and mandibular remains, the second one upon the limb bones and this last on the metapodia and tarsals. On the basis of the metapodial morphometrics seen in the various diagrams we suggest that with some exceptions the greater part of the analyzed material is referred to *U. spelaeus*, although smaller in comparison with the typical *U. spelaeus* of Italian and other localities. Further, the morphometric base has supported the morphological one suggesting that all the analyzed fossils belong in the *U. spelaeus* group, but nevertheless we have some cases of fossils with characteristics of *U. spelaeus* and of *U. deningeri*, as the morphological and morphometric data have indicated. An evaluation of the "K-index" (GUZVICA & RADANOVIC-GUZVICA, 2000) has shown a value of 7.79 for the II metatarsus. Usually this index is good for a preliminary check of the stratigraphic position of a cave bear population. With 7.79 the Buco dell'Orso bears are far beyond all the members of the cave bear group (Withalm *pers. com.*). In fact, the comparison between the Buco dell'Orso remains and those from the Repolust Cave (Styria, Austria, small *U. deningeri* bears) and Conturines Cave (South Tyrol, Italy) placed them in the lower quarter of the variation of the cave bear group. The bears from Repolust Cave are by far the smallest and those from Conturines Cave seem to be closely related to the common *deningeri* ancestors (Withalm *pers. com.*). The presence of the *Ursus arctos*

is excluded, as already seen for the other anatomical parts (skulls + mandibles, limb bones, SANTI & ROSSI, 2001; ROSSI & SANTI, 2001 a).

An important feature is the sexual dimorphism of the fossils. In various diagrams the position of the fossils close to the specimens considered as females is clear (I metacarpus, IV metacarpus, I metatarsus) in relation to the ones considered as small males (III metatarsus, WEINSTOCK, 1999). The smaller size shown by the bears of the Buco dell'Orso cave may indicate a greater age for these in comparison with the typical *U. spelaeus*, as already suggested by ROSSI & SANTI (2001 b). This hypothesis is enhanced by the recent study of PEREGO *et al.* (2001) on the cave bears from Grotta Sopra Fontana Marella (Varese, Lombardy, Northern Italy), where the authors consider the smaller bears to be the oldest.

According to RABEDER & NAGEL (2001) the size reduction should link to the "regressive evolution" phenomenon. GERHARD (2001) on the base of the studies on metapodia coming from Italian and Austrian caves, arrived to the same conclusions.

To the last the chronological position is not clear. There is a possibility of a Würmian age, but also a Middle Pleistocene (Rabeder *pers. com.*) cannot be excluded.

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Explanation of plates

All the figured specimens are housed in the collections of the Museo Civico di Storia Naturale in Milano.

PLATE 1

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

SCAPHOLUNAR. A – Specimen n. 1 left, proximal view. B – Specimen n. 1 left, distal view.

PYRAMIDAL. C – Specimen n. 4 left, proximal view. D – Specimen n. 4 left, distal view. E – Specimen n. 1 left, proximal view.

F – Specimen n. 1 left, distal view.

Scale: 1 cm.

PLATE 2

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

PISIFORM. A – Specimen n. 2 right, medial view. B – Specimen n. 2 right, lateral view.

UNCINATE. C – Specimen n. 1 right, distal view. D – Specimen n. 1 right, proximal view.

I METACARPUS. E – Specimen n. 2 left, palmar view. F – Specimen n. 2 left, dorsal view. H – Specimen n. 20 left, dorsal view.

I – Specimen n. 20 left, palmar view. G – Specimen n. 5 left, medial view.

II METACARPUS. J – Specimen n. 12 left, lateral view. K – Specimen n. 12 left, medial view. L – Specimen n. 11, lateral view.

M – Specimen n. 11 left, medial view.

I PHALANX. N – Specimen n. 26, palmar view.

Scale: 1 cm.

PLATE 3

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

III METACARPUS. A – Specimen n. 2 left, medial view. B – Specimen n. 2 left, lateral view. C – Specimen n. 5 right, medial view.
D – Specimen n. 5 right, lateral view. E – Specimen n. 6 right, lateral view. F – Specimen n. 6 right, medial view. G – Specimen n.
6 left, medial view. H – Specimen n. 6 left, lateral view.

Scale: 1 cm.

PLATE 4

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

IV METACARPUS. A – Specimen n. 6 right, medial view. B – Specimen n. 15 left, medial view. C – Specimen n. 15 left, lateral view.

V METACARPUS. D – Specimen n. 7 left, medial view. E – Specimen n. 7 left, palmar view. F – Specimen n. 6 right, lateral view.

G – Specimen n. 6 right, medial view.

Scale: 1 cm.

PLATE 5

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

ASTRAGALUS. A – Specimen n. 8 left, dorsal view. B – Specimen n. 8 left, plantar view.

HEEL. C – Specimen n. 1 right, dorsal view. D – Specimen n. 1 right, plantar view.

SCAPHOID. E – Specimen n. 5 left, proximal view. F – Specimen n. 5 left, distal view.

CUBOID. G – Specimen n. 5 left, medial view. H – Specimen n. 5 left, distal view.

Scale: 1 cm.

PLATE 6

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

I METATARSUS. A – Specimen n. 2 right, medial view. B – Specimen n. 2 right, lateral view. C – Specimen n. 2 right, plantar view.

D – Specimen n. 6 right, medial view. E – Specimen n. 3 right, lateral view.

II METATARSUS. F – Specimen n. 2 left, lateral view. G – Specimen n. 3 right, medial view. H – Specimen n. 3 right, lateral view.

I – Specimen n. 5 right, medial view. J – Specimen n. 5 right, lateral view.

III METATARSUS. K – Specimen n. 9 right, medial view.

Scale: 1 cm.

PLATE 7

Ursus spelaeus ROSENMÜLLER-HEINROTH, 1784. Buco dell'Orso Cave (Laglio).

III METATARSUS. A – Specimen n. 3 left, lateral view.

IV METATARSUS. B – Specimen n. 3 left, medial view. C – Specimen n. 3 left, lateral view. D – Specimen n. 2 left, medial view.

E – Specimen n. 2 left, lateral view.

V METATARSUS. F – Specimen n. 8 left, medial view. G – Specimen n. 8 left, lateral view. H – Specimen n. 6 right, medial view.

I – Specimen n. 3 left, medial view. J – Specimen n. 1 right, lateral view.

Scale: 1 cm.



A



B



C



D



E



F

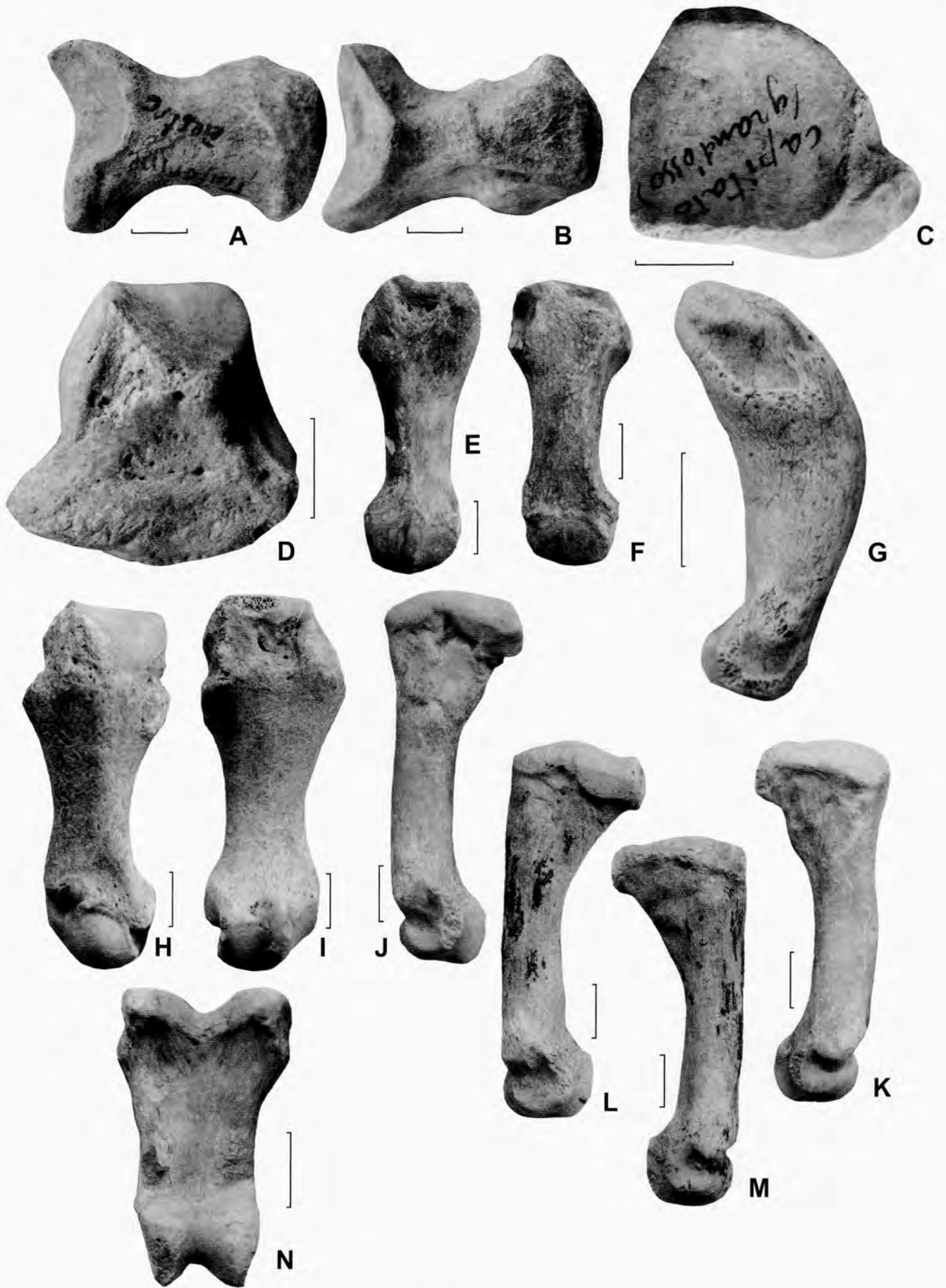


PLATE 2



PLATE 3

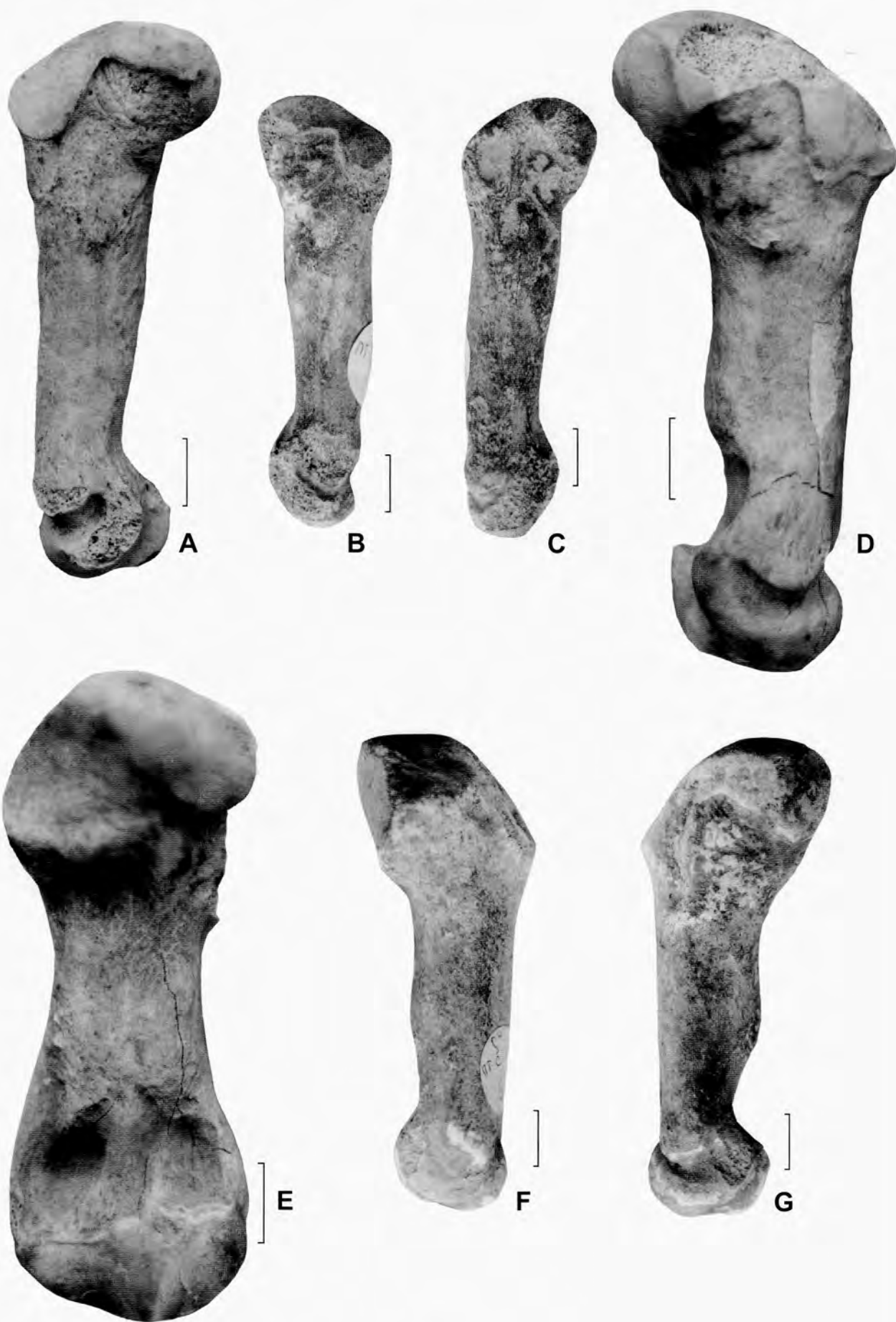


PLATE 4

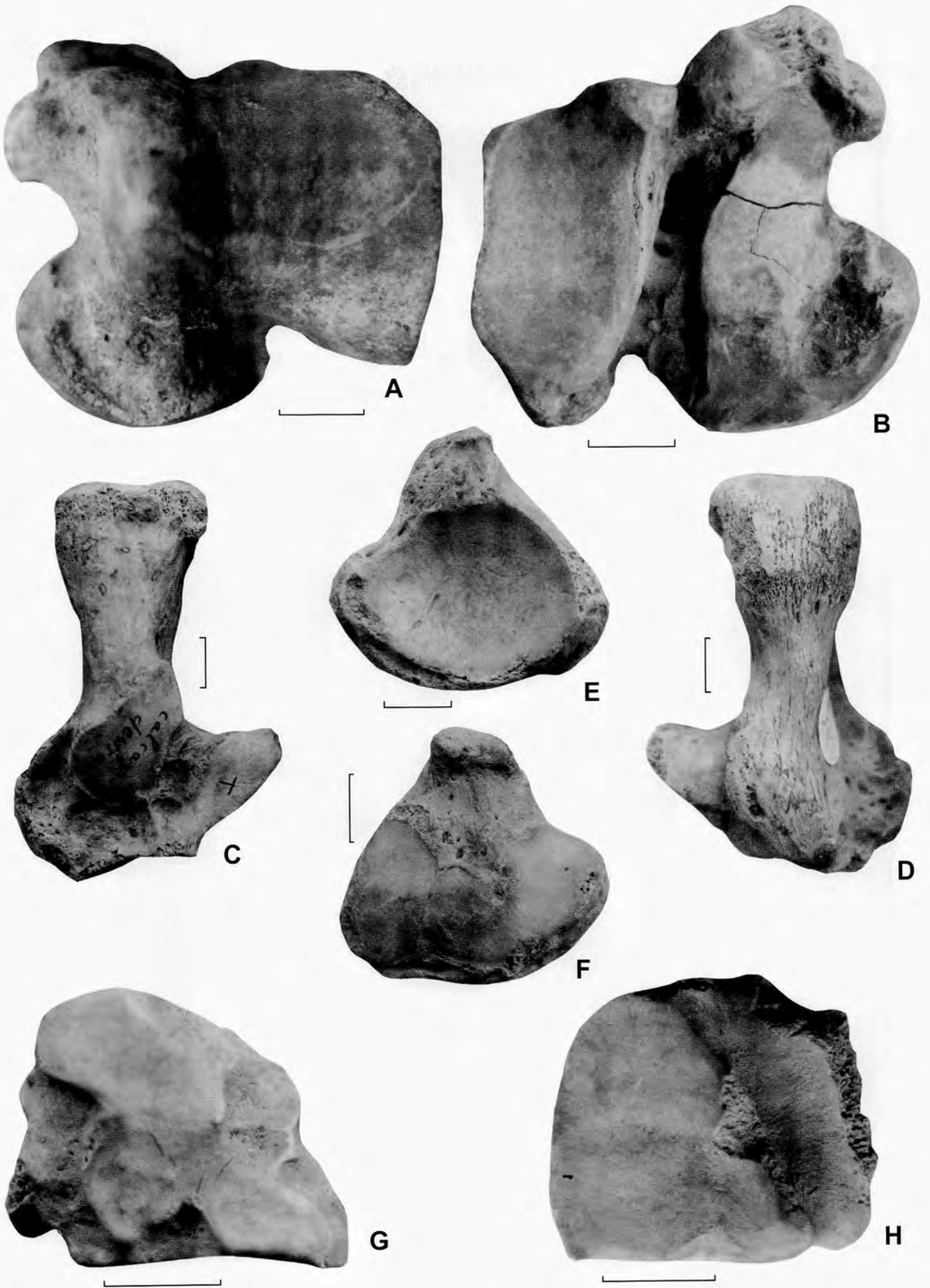


PLATE 5

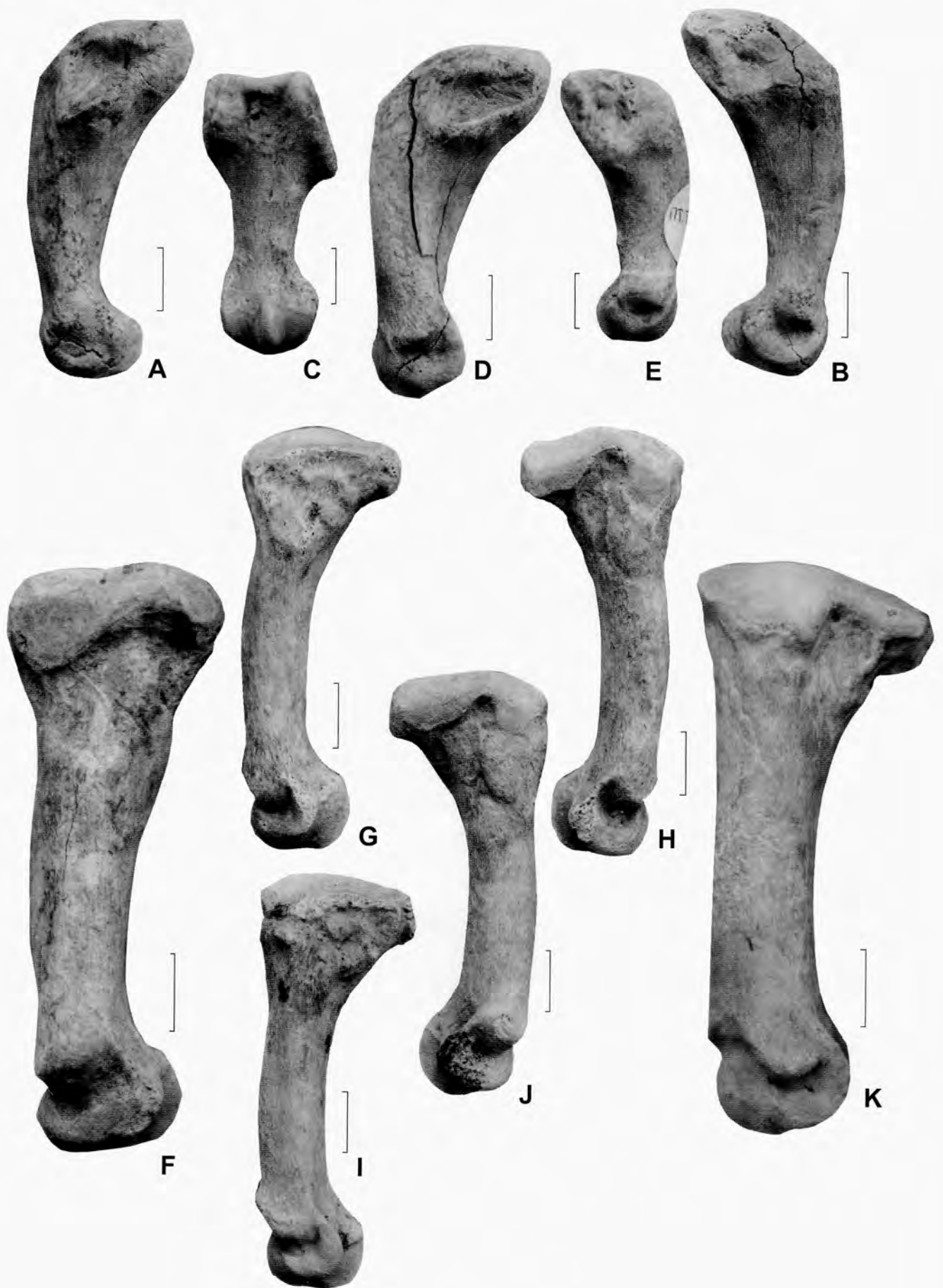


PLATE 6



PLATE 7

