

# A skeletal comparison of Domestic Dog (*canis familiaris*), Red Fox (*vulpes vulpes*), Badger (*meles meles*) and Domestic Cat (*felis catus*).

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2015

## Acknowledgements

I owe a debt of gratitude to the University of Exeter Archaeology department for providing the reference collection from which the specimens are sourced.

## Introduction

This comparative analysis of the skeletal elements of dog, fox, badger and cat is intended to provide a digital accessible comparison between the species. The differences noted between the specimens originates from my own visual comparison and could be affected by peculiar preservation/characteristics of our reference collection or observer error, or from sexual dimorphism as the sex of the specimens used was unknown. Still, the images should allow researchers to identify the major morphological differences between species.

Where possible, all elements used for the images were from the left side. The one exception to this is in the ulna, where a right badger ulna was used as the left was broken. In some cases the left and the right elements were fused (the fox mandible and the dog and fox pelves).

The specimens used were those in the University of Exeter's zooarchaeological reference collection. They are as follows:

Dog: *Canis familiaris*

Red Fox: *Vulpes vulpes*

Badger: *Meles meles*

Cat: *Felis catus*

Unless otherwise stated, all photographs of elements are displayed in this order.

The elements identified are thus:

- |                  |          |              |
|------------------|----------|--------------|
| • Mandible       | • Radius | • Tibia      |
| • Atlas and Axis | • Ulna   | • Calcaneum  |
| • Scapula        | • Pelvis | • Astragalus |
| • Humerus        | • Femur  |              |

Not featured: cranium, vertebral column, sacrum, fibula, metapodia, phalanges.

## MANDIBLE

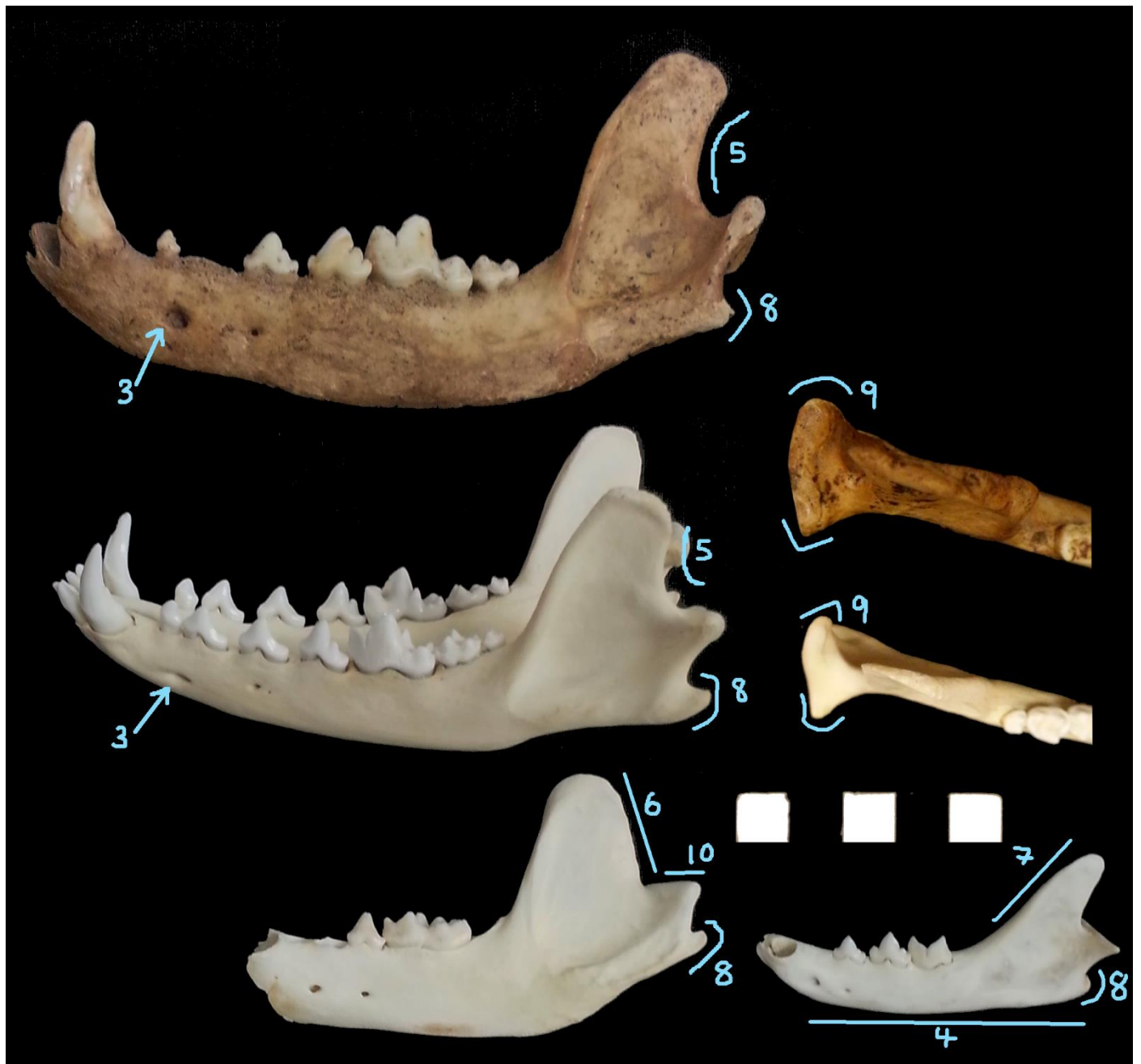


Figure 1: Left Mandible of dog (top), fox (middle), badger (bottom left) and cat (bottom right), lateral view, and mandibular hinge of dog (top) and fox (bottom), proximal view (middle right).

## MANDIBLE

Overall	1	Dog more robust than fox; badger and cat smaller than dog and fox.
Tooth row	2	Dog and fox have similar cheek teeth. Badger slightly different shaped carnassial with many peaks. Cats very different tooth morphology (two premolars and one molar).
	3	Mental foramen circular in dog, more oval in fox.
	4	Cat mandible more or less flat from corpus mandibulae to the ascending ramus compared to others.
Mandibular hinge	5	Mandibular hinge curves more posteriorly in dog than fox.
	6	Badger: mandibular hinge is vertical, without curvature to the posterior.
	7	Cat: mandibular hinge is in a reclined position.
Ascending Ramus	8	Extends past mandibular condyle in badger, does not extend past in dog, fox or cat.
Mandibular Condyle	9	Blunter laterally and sharper medially in dogs, the opposite in fox.
	10	Resembles a 'rolled scroll' in badger, sits horizontally level.

## ATLAS and AXIS

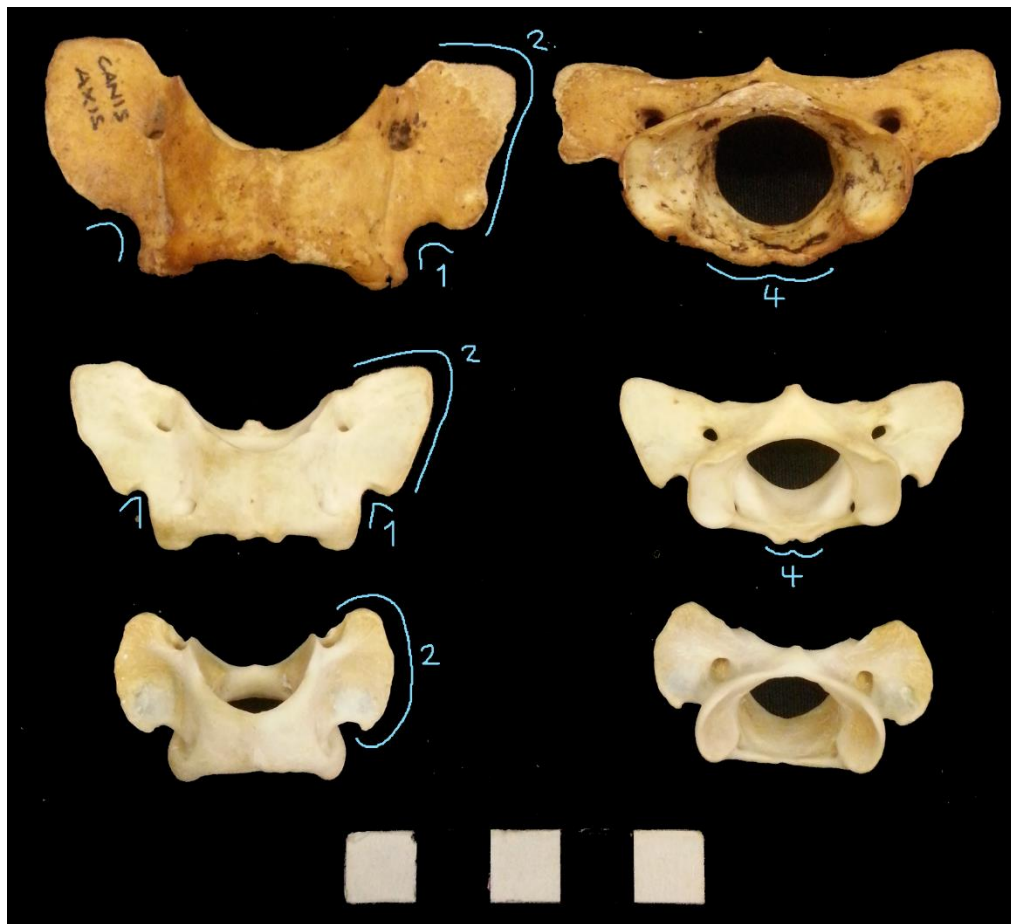


Figure 2: Atlas of dog (top), fox (middle) and cat (bottom), ventral view (left) and cranial view (right).



Figure 3: Axis, dorsal view (top), lateral view (bottom).

## ATLAS

Overall	1	Notches in 'wings' are sharper in fox than in dog.
	2	'Wings' in cat are almost symmetrical. Pointed at the top in dog and fox.
	3	General size and robustness of dog exceeds that of fox and cat.
	4	Tubercles more defined in fox.

## AXIS

Overall	1	Fox less robust than dog.
	2	Badger vertebral spine extends further distally than proximally. In dog, fox and cat the spine extends more or less to the position of the odontoid peg.



## SCAPULA

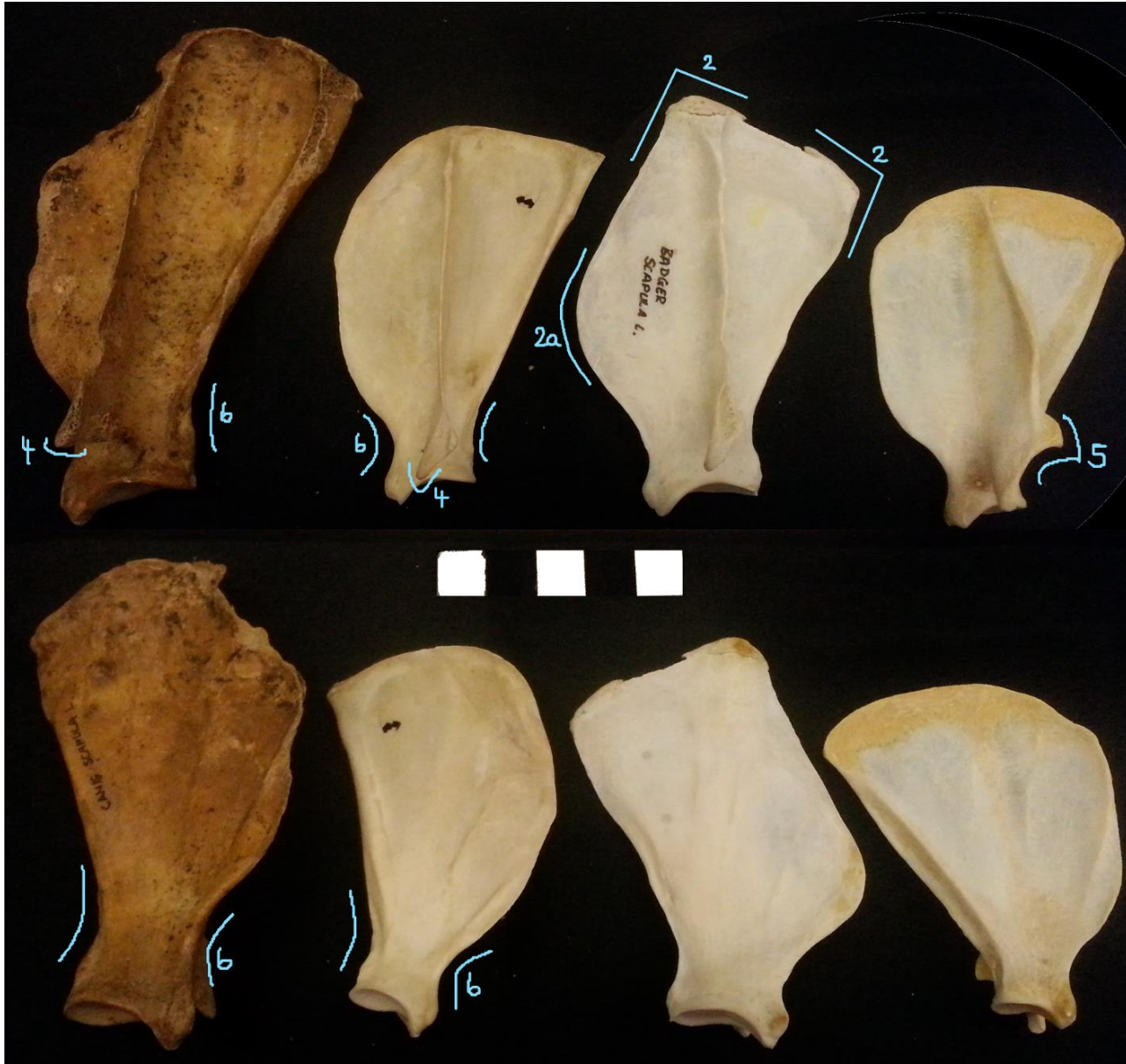
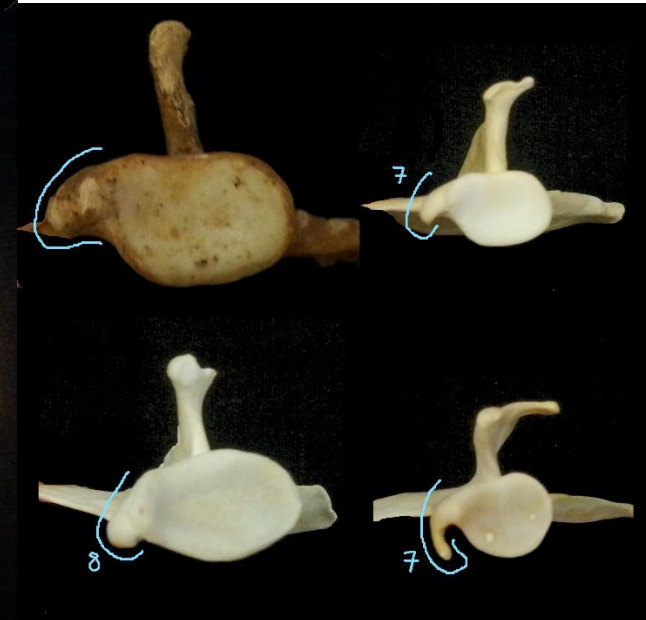


Figure 4: Scapula, medial (top), lateral (bottom left), and distal (below) views.



## SCAPULA

General shape	1	Dog more robust than fox.
	2	Badger scapula blade rectangular in shape, thanks to curve of 2a.
	3	Cat blade is very thin.
Acromion	4	Spine extends further over glenoid cavity in fox than dog.
	5	Cat spine has distinctive hook.
Neck	6	Fox has relatively slimmer neck than dog, especially waisted above the tuber scapulae.
Distal articulation	7	Tuber scapulae more obviously hooked in fox (as opposed to dog) and especially cat, extending almost beyond the glenoid cavity.
	8	Badger: tubercle not well defined, barely extends out from the glenoid cavity.

# HUMERUS

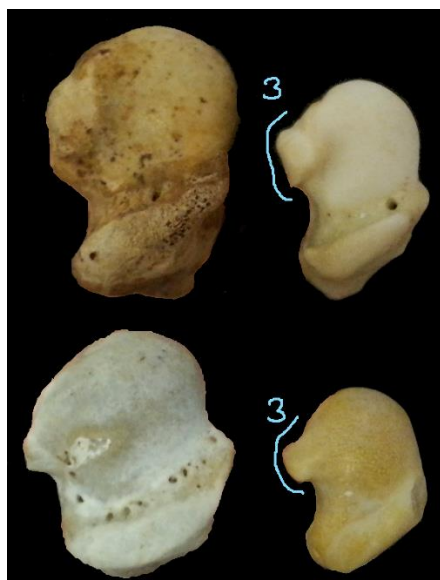


Figure 5: Humerus, anterior, posterior, medial and lateral views (top), proximal view (left).



## HUMERUS

Overall	1	Badger squat and chunky; dog, fox and cat longer and more gracile.
	2	Dog more robust than fox.
Proximal Articulation	3	More pronounced facet on humeral head in fox and cat.
	4	Lateral tuberosity and humeral head more or less level in badger.
Shaft	5	Deltoid tuberosity and ridge relatively more pronounced in fox than in dog.
Distal Articulation	6	Wing on lateral distal shaft is wide and pronounced in badger, smaller but present in cat, absent in fox and dog.
	7	Circular hole in distal articulation of dog and fox.
	8	'Eyelet' oval hole in the medial edge of distal articulation in badger and cat.
	9	Condyles more level in dog; lateral condyle raised in fox, badger and cat.

## RADIUS



Figure 6: Radius, anterior and posterior views (top), proximal (bottom left) and distal (bottom right) views.

## RADIUS

Overall	1	Badger: twisted shaft, small and squat.
	2	Cat: shaft thin and gracile with very small proximal epiphysis.
Proximal epiphysis	3	Notch in posterior proximal articulation in fox.
	4	Obvious lump on lateral proximal shaft in cat, visible from view of proximal articulation.
Distal epiphysis	5	Projection on medial distal shaft/epiphysis is more prominent in badger and cat, and mild in fox, creating a clear step out step down profile (slight/absent in dog).
	6	Sharper distal projection in fox and badger; smaller and more rounded in dog and cat.

## ULNA

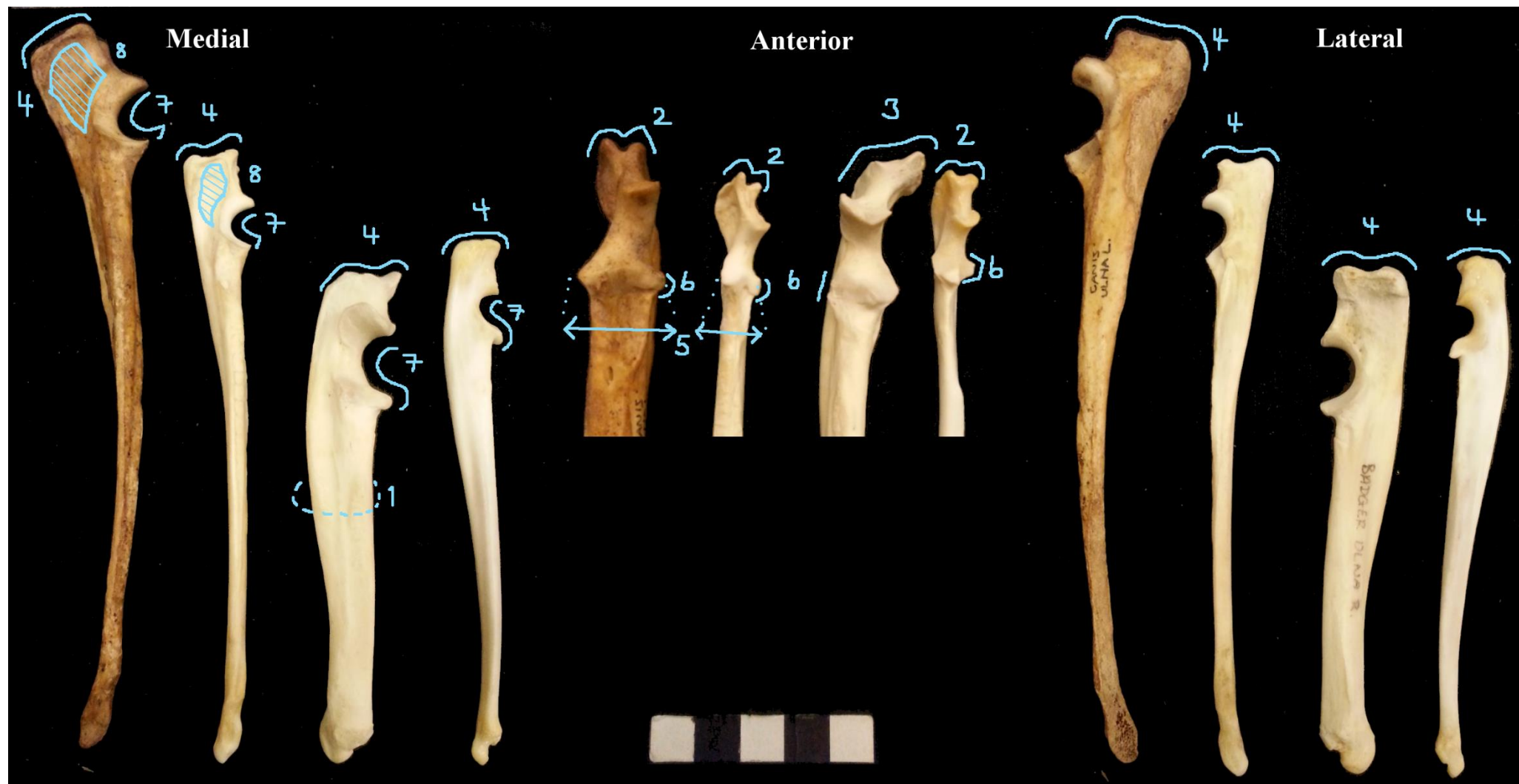


Figure 7: Ulna, medial, anterior and lateral views.

NB the badger ulna is from the right side.

## ULNA

Overall	1	Badger squat and wide, with a chunky anterior-posterior shaft.
Olecranon	2	More uneven medio-laterally in fox than in dog. Both rounded but sharper than cat.
	3	Deviates medially in badger.
	4	Side aspect: dog relatively flat and at a slight inclined angle; fox and badger depression between posterior and anterior; cat flat and rounded.
Articulation surface	5	Dog much wider than fox.
	6	Lateral facet droops slightly downwards in dog and fox, projects horizontally in cat, almost absent in badger.
	7	Dog and fox have enclosed 'C' shaped articulation in side view culminating in pointed end. Badger and cat droops at distal part causing lip under articular surface.
	8	Shaft behind/above articulation is more concave in dog and fox.



PELVIS

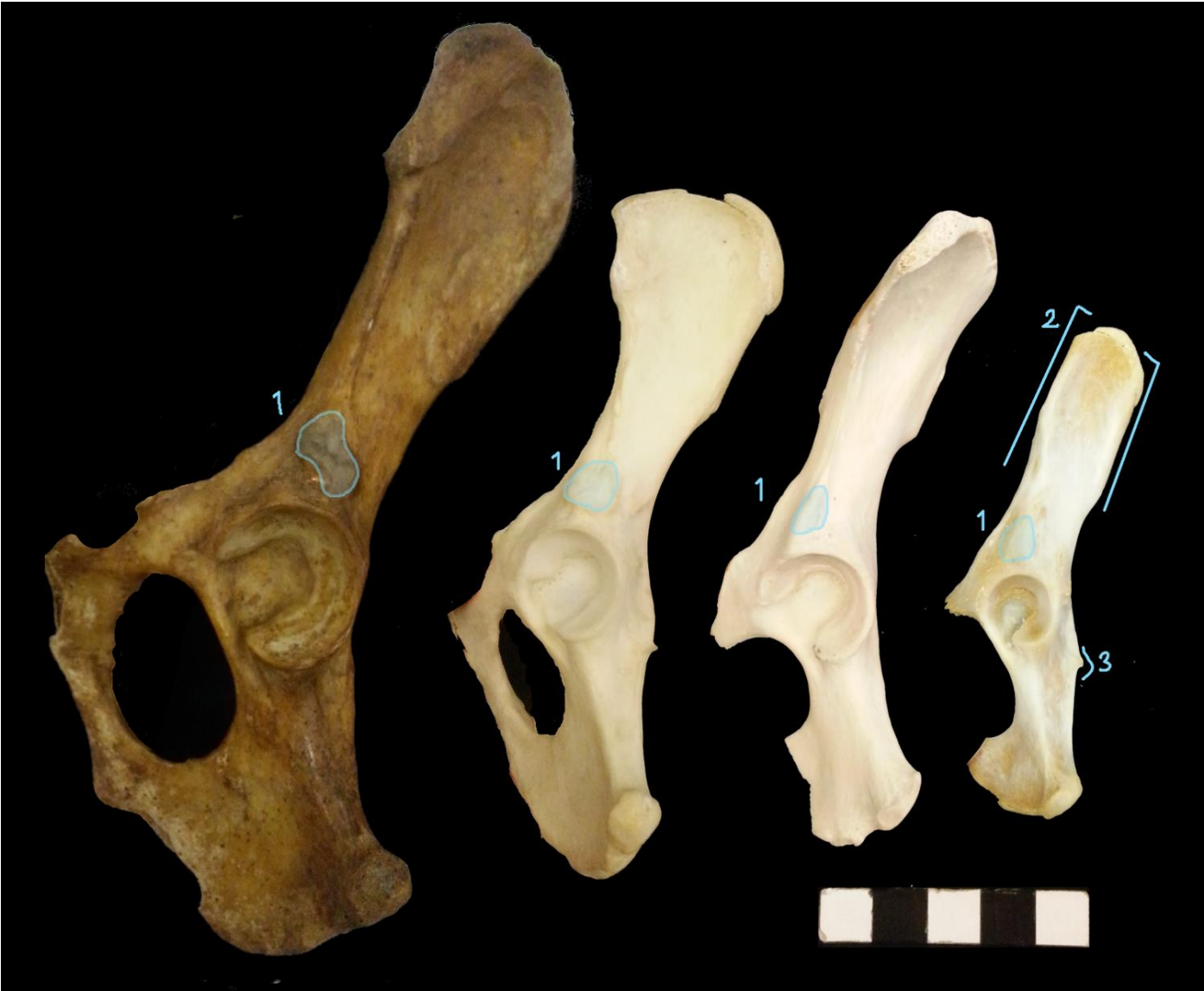


Figure 8: Pelvis, lateral view

NB sexual dimorphism a possible cause for differentiating characteristics.

PELVIS		
Overall	1	Fox and dog both have a lump above the acetabulum; less well defined lump in badger and cat but not depression as in other mammals.
	2	Ilium does not flare into articular surface in cat.
	3	Protrusion on ischium in cat.

# FEMUR

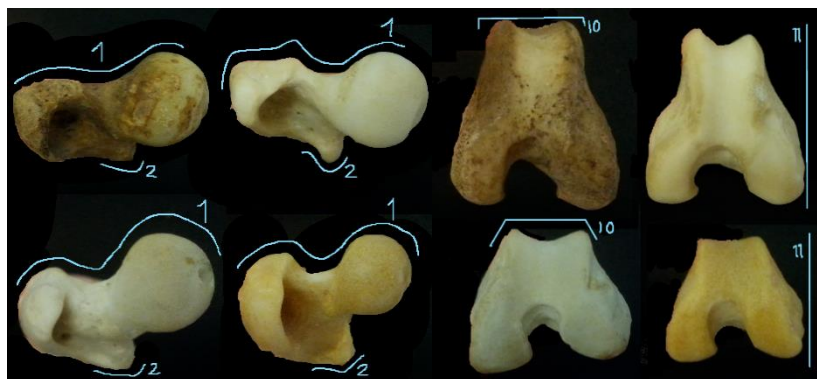
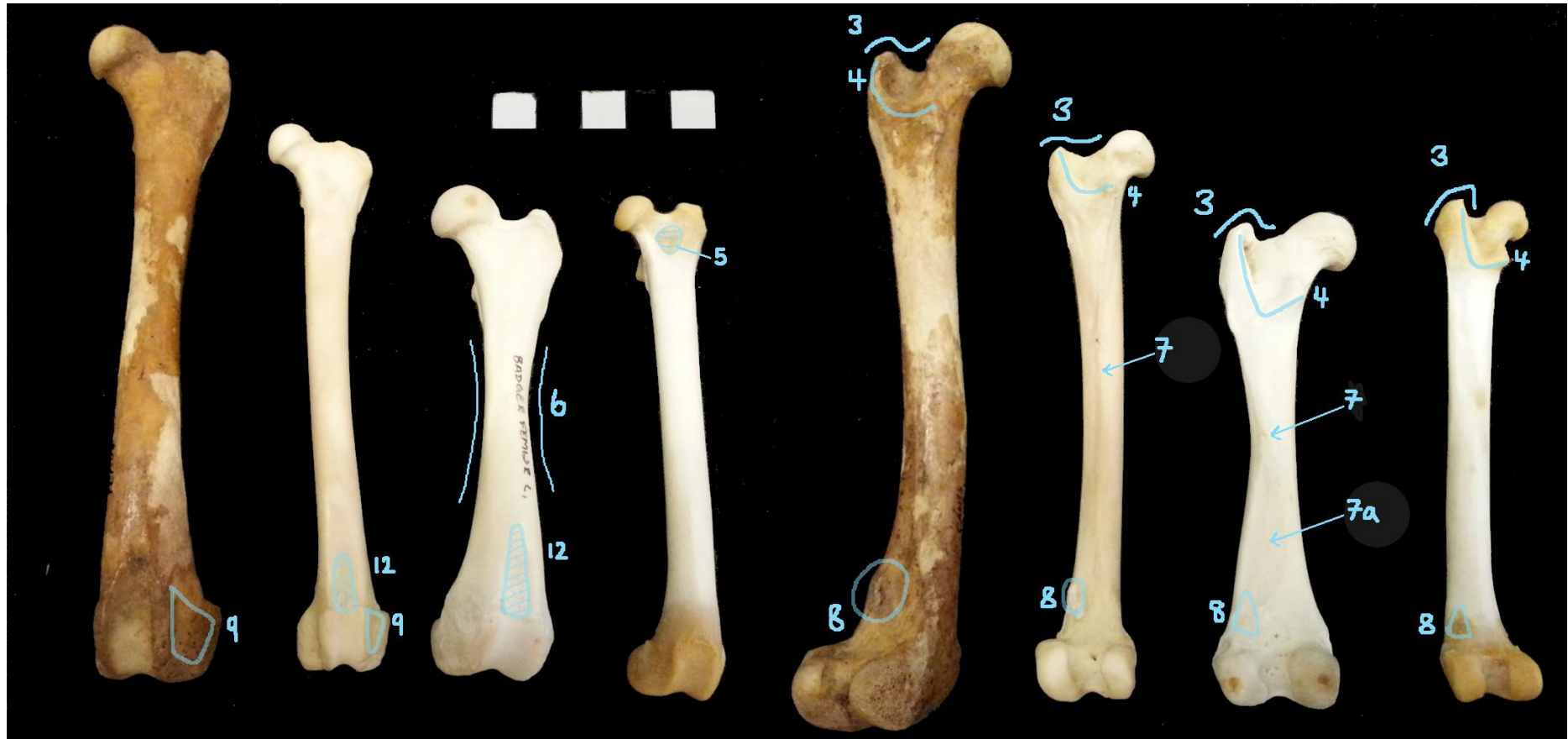


Figure 9: Femur, anterior (top left) posterior (top right), proximal (bottom left) and distal (bottom right) views.

## FEMUR

Proximal Articulation	1	More rounded anteriorly (distal view) in dog than in fox. Femoral head deviates further anteriorly in badger and cat.
	2	Trochanter minor extends further posteriorly in fox than in dog, badger and cat.
	3	Trochanter major extends further proximally in dog (and badger, cat). Relatively flat in fox
	4	Continuous sweeping line from trochanter major to minor in dog and fox. More angular in badger and cat.
	5	Depression below femoral head and trochanter on anterior surface in cat.
Shaft	6	Cat has relatively straight shaft; dog and fox slightly thinner at midshaft; badger more obviously waisted.
	7	<i>Linea aspera</i> relatively more pronounced in fox than dog. In badger is only defined until foramen at midshaft then continues as a rough area (7a).
Distal epiphysis	8	Depression above the lateral condyle on the posterior shaft in cat (as seen in the larger mammals). In dog and fox this is a small rough bump; in badger relatively flat.
	9	Lateral surface between the lateral condyle and trochlea is relatively flat in dog, concave in fox.
	10	Trochlea is wider in badger and cat compared to the two condyles and has a more trapezium shape.
	11	Distal epiphysis is longer anterior-posterior in dog and fox than badger and cat.
	12	Depression above trochlea forming two parallel ridges on the distal anterior shaft in fox and badger, absent or slight in dog and cat.

## TIBIA

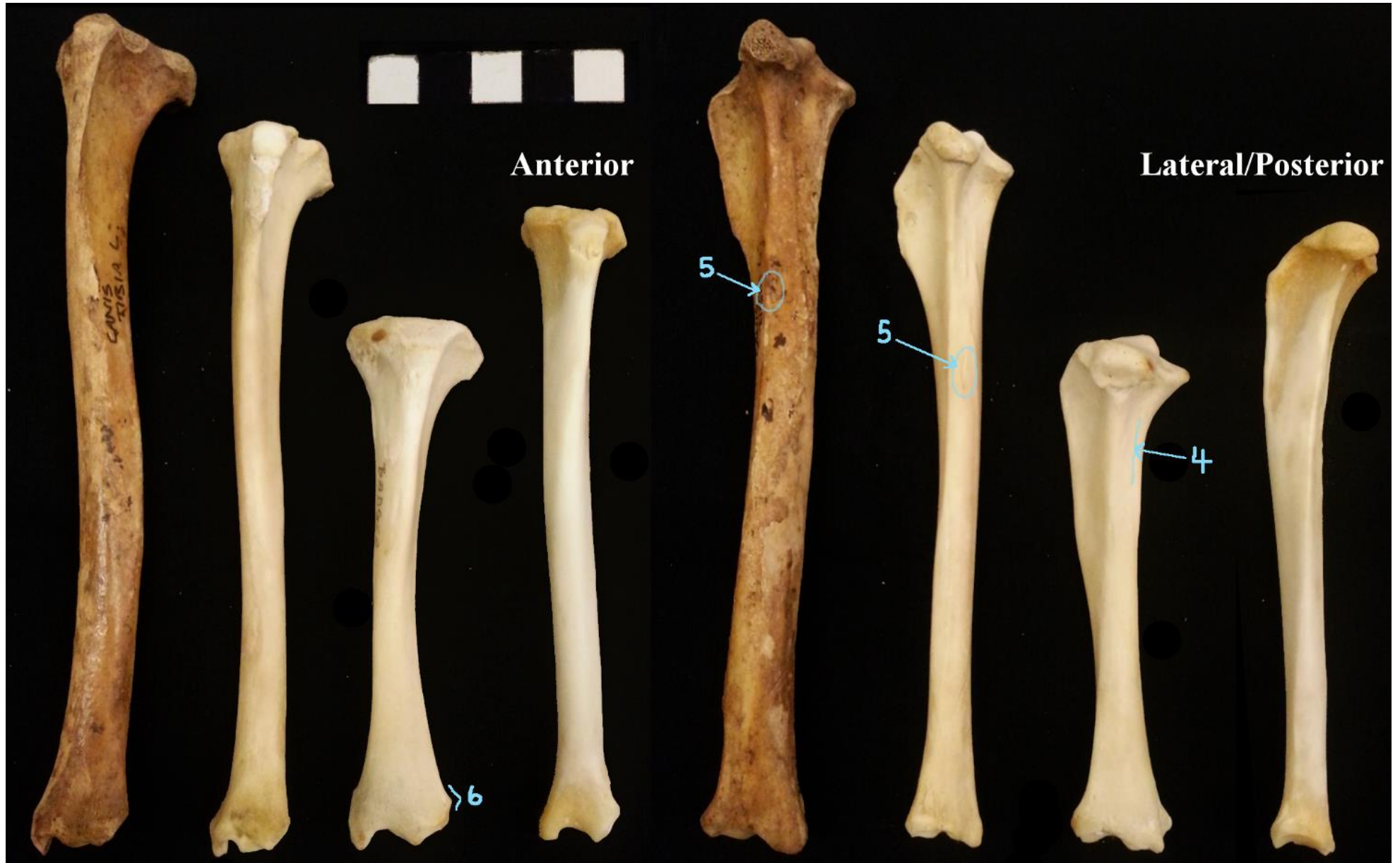


Figure 10a: Tibia, anterior and posterior views.



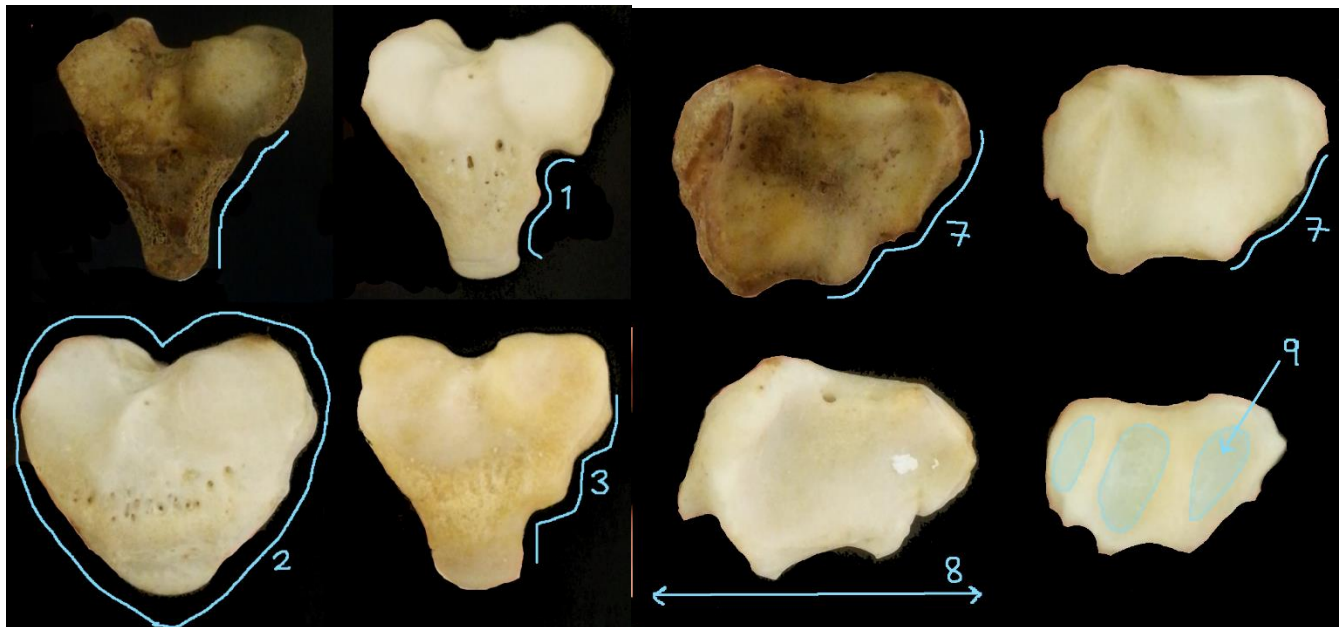


Figure 10b: Tibia, proximal (left) and distal (right) views.

TIBIA		
Proximal articulation	1	Notch in proximal articulation more pronounced in fox than in dog.
	2	Heart shaped proximal articulation in badger.
	3	Three 'steps' on lateral side of proximal articulation in cat.
	4	Lip on medial edge of proximal posterior face in badger.
Shaft	5	Nutrient foramen closer to edge of posterior face in dog, slightly more central in fox.
	6	Projecting bump on lateral side of distal articulation in badger.
Distal epiphysis	7	Lateral malleolus is a relatively smooth curve in fox, definite step in dog.
	8	Wider articulation with shallower grooves in badger.
	9	Three facets on distal epiphysis in cat, on projection of lateral malleolus.



## CALCANEUM and ASTRAGALUS



Figure 11: Calcaneum, anterior (top) and medial (bottom) views.

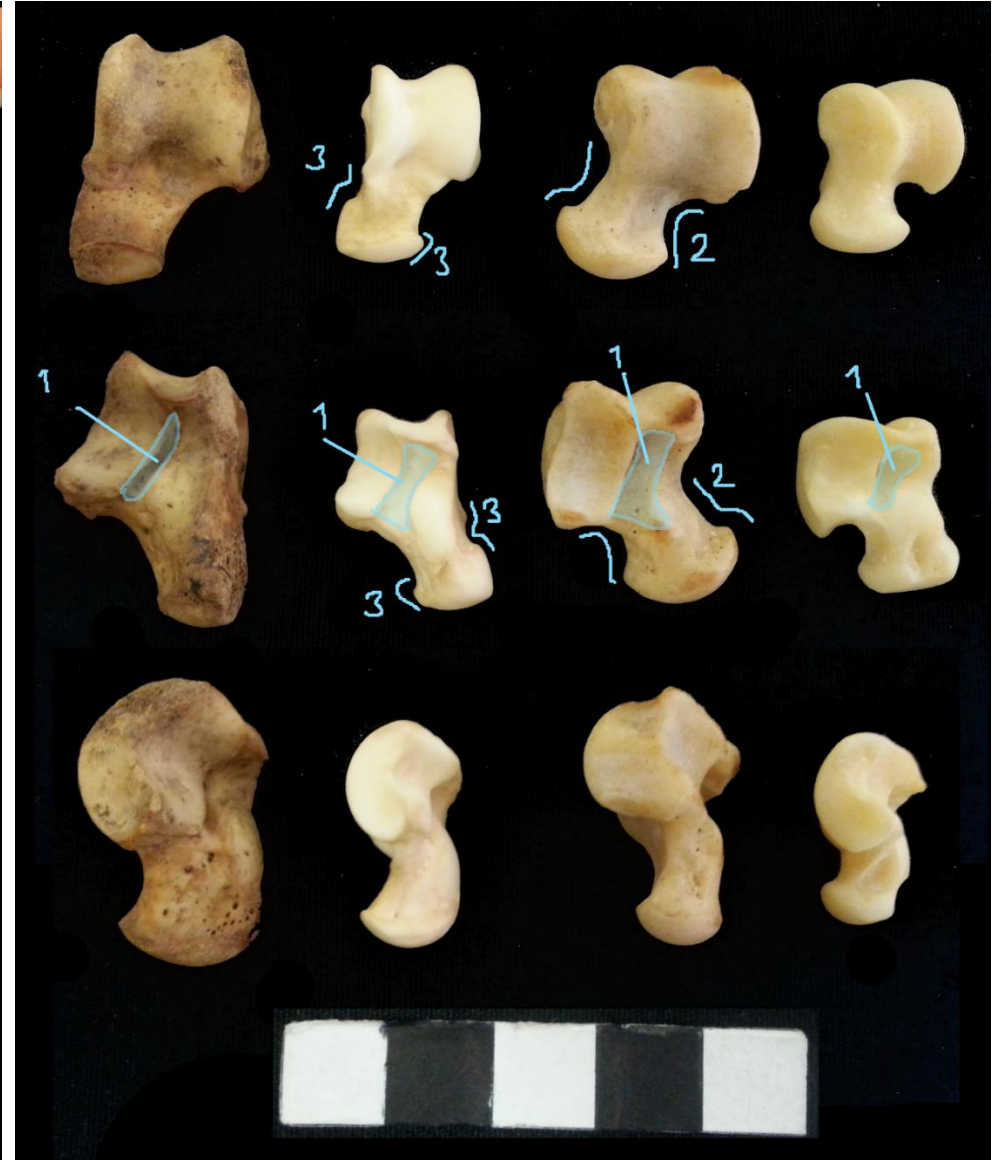


Figure 12: Astragalus, anterior (top), posterior (middle) and lateral (bottom) views.

## CALCANEUM

Sustentaculum	1	More curved towards the distal in dog, flatter in fox.
	2	Two small facets on sustentaculum and distal tuberosity in fox and dog, one large facet in badger, one thin continuous facet in cat.
	3	(From caudal view) Sustentaculum is <ul style="list-style-type: none"><li>• D shaped in dogs,</li><li>• Scalene triangle-shaped in fox with short proximal side,</li><li>• Circular and curving in badgers,</li><li>• Isosceles triangle-shaped in cats.</li></ul>

## ASTRAGALUS

Overall	1	Two distal facets close together in fox and especially dog, further separated in badger and cat.
	2	Distal projection swings medial wider in badgers, with a definite neck.
	3	Step down and lip in fox on distal projection, not in dogs.