BEGINNER’S GUIDE

to Identifying British Mammal Bones

By Nicola Prehn, Florin Feneru and John Rochester
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Introduction

When visiting the countryside, or strolling along the beach, walkers often come across items that they believe to be bones, teeth or fossils. The first question is ‘what is it?’ and in the quest to unravel the mystery, many of these fragments find their way to the free, public access identification service at the Angela Marmont Centre (AMC) in the Natural History Museum in London.

Based on specimens most commonly submitted to the AMC for identification, this beginner’s guide focusses on the twelve most prevalent wild and domestic mammals in the UK. The guide is not intended for specialists or to be exhaustive, as identifying the full range of bones and teeth from all UK species would be prohibitively detailed. However, many of the remains found in the UK, particularly in urban and agricultural locations, are those of domestic animals, so it is useful to recognise these early. For this reason, the guide has clearly separated wild from domestic animals to help the reader distinguish between the two.

For further help with identification, please submit requests to the NHM identification forum.

Introduction to bones

Bone can be easily confused with stone, rock or concretion (lumps of minerals). However, there are some key differences:

1. A cross section of a bone will contain different structures and canals whereas a non-biological object will be solid and uniform in appearance throughout.

2. Bones will contain various markings, holes and ridges where muscles attach or blood vessels travel, which can help with identification and distinguish them from non-organic matter.

When first finding a bone, it’s important to check whether it’s okay to keep the bones.
There is no single hard-and-fast rule for distinguishing rock from bone, but there are a few principles that can help you tell the difference:

1. Compare to surrounding rock.
2. Check the internal structure.

<table>
<thead>
<tr>
<th>Description</th>
<th>Fossil</th>
<th>Bone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preserved remains or traces of animals, plants, or other organisms.</td>
<td>A structure that forms part of the skeleton of a vertebrate animal.</td>
</tr>
<tr>
<td>Types</td>
<td>Two types – body fossils which are the remains of an animal (such as bones) and trace fossils which are signs of the animal’s presence (such as footprints).</td>
<td>Two types – compact and spongy, which can be described as long, short, flat, irregular, sesamoid or sutureal.</td>
</tr>
</tbody>
</table>

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Mammals, fish and birds are all vertebrates in that they all have an internal skeleton with a segmented spinal column.

The structure of the bones vary widely to support the lifestyle, habitat and behaviour of each animal group.

<table>
<thead>
<tr>
<th>Description</th>
<th>Mammals</th>
<th>Fish</th>
<th>Birds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strong, rigid bones to provide structural support and protect organs and soft tissue.</td>
<td>Skeleton is made up of strong, lightweight bone and cartilage adapted to allow easy movement through the water.</td>
<td>Unique bone features to aid flight such as a furculum (or wishbone) and an extended sacrum along the spine of fused vertebrae.</td>
</tr>
<tr>
<td>Bone characteristics</td>
<td>• Heavy</td>
<td>• Light</td>
<td>• Light</td>
</tr>
<tr>
<td></td>
<td>• Rounded</td>
<td>• Glossy</td>
<td>• Not translucent but sometimes glossy</td>
</tr>
<tr>
<td></td>
<td>• Dense at the end</td>
<td>• Semitranslucent</td>
<td>• Smooth texture</td>
</tr>
<tr>
<td></td>
<td>• Not glossy or translucent</td>
<td>• Flat and angular</td>
<td>• Thin support webs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Wishbone</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Many hollow bones</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Beak instead of teeth</td>
</tr>
</tbody>
</table>

Fossil vs Bone.

Types of Bone.
Domestic skull comparison:

Domestic mandible comparison:

Wild skull comparison:

Wild mandible comparison:
A mammal’s complete skull is made up of around 34 bones, though many of these are fused together to form three main areas – the braincase, the rostrum (upper jaw) and mandible (lower jaw).

The size of the skull can give an initial indication to the type of the animal. However, this is only indicative as shapes and sizes differ widely between breeds and change considerably with the age of the animal.
No incisors on the lower jaw. Long jaw. Many breeds have horns.

High, flat skull.

Flat and broad forehead with a large skull vault.

Wide, stocky skull.

Stocky jaws.
Head – Skull – Domestic

**Dog**

Circular depression in front of the eye socket.

Robust skull.

**Sheep (Texel)**

Long nasal cavities and large round eye sockets. The area in front of the eye socket has a few round holes. Many breeds have horns.

Long nasal cavities.

No incisors on the upper jaw.
Head – Skull – Wild

Badger

High crest down the middle.

Large round eye sockets. The area in front of the eye socket does not have bone and the inside of the nose is visible. Males have antlers.

Roe deer

High crest down the middle.

Large eye sockets on the side of the head.

No incisors on the upper jaw.
Head – Skull – Wild

**Foil**
- Sharp canines with an oval depression in front of the eye socket.

**Grey seal**
- Sloping forehead with edges upturned at the rear edge of the skull.
- Upturned edges to the back of the skull.

Long narrow skull.
Head – Skull – Wild

Rabbit

- Second pair of small incisors slotted behind the front teeth.

- Small, narrow skull.

Squirrel

- Large nasal opening with orange tint to the front teeth.

- Small compact skull.
The mandible, or lower jaw, carries the lower teeth and are a pair of bones attached together at the chin.

Each half of the mandible has a hinge joint with the skull to enable the jaw to open and close.

In front of the hinge joint is a coronoid process which provides attachment for some of the chewing muscles.

Mammals which eat meat have prominent canines and the other teeth tend to have spikes.

Plant eating mammals need to grind their food and have flat topped cheek teeth with a characteristic pattern of ridges. Plant eaters also have a gap between the incisors at the front of the mandible and the cheek teeth.

**Cat**

Three teeth behind the canine - two premolars and a molar mandible shorter and flatter than a dog.

**Cow**

Large mandible with a long gap between the incisors and premolars, curved coronoid extending well above the hinge joint.

**Dog**

Robust mandible with a broad coronoid. Multiple sharp spiky teeth and a round hole just behind the canine (mental foramina).

**Horse (feral)**

Broad mandible at the back tapering to become narrow at the front with a relatively straight lower edge. Hinge joint sticking out to the side and the coronoid is straight.

**Pig (Berkshire)**

Very broad back to the mandible with a small coronoid only just above the hinge joint. Teeth have multiple cusps, similar to human teeth.

**Sheep (Texel)**

Similar to cow but much smaller with a more prominent coronoid.
Head – Mandible – Wild

Similar to sheep but generally narrower with a large curved coronoid. Distinctive shape and orange on the incisors which is found in all rodents. The cheek teeth have cusps and look a bit like tiny human teeth.

Similar to dog but slimmer with an oval mental foramen. Distinctive shape only found in rabbit and hare. Long gap between incisors and cheek teeth.

Broad coronoid and closely spaced teeth. Similar row of teeth each with a single spike.
Teeth are often found, as they tend to survive longer than other bones, and even individual teeth may be identified. The front most teeth are incisors with the canines lying slightly further back. The cheek teeth are divided into premolars towards the front and molars towards the back of the mouth.

Each animal has a dental formula which identifies the number of incisors (I), canines (C), premolar (P) and molar (M) in one half of the upper and lower jaw. The number is doubled to identify the full complement and as the number may differ from top jaw to bottom, the formula lists the top and then the bottom for each.

<table>
<thead>
<tr>
<th>Teeth</th>
<th>Domestic Cow</th>
<th>Domestic Dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisor</td>
<td>3/2</td>
<td>3/3</td>
</tr>
<tr>
<td>Canine</td>
<td>1/1</td>
<td>1/1</td>
</tr>
<tr>
<td>Pre-molar</td>
<td>3/3</td>
<td>4/4</td>
</tr>
<tr>
<td>Molar</td>
<td>2/3</td>
<td>3/3</td>
</tr>
</tbody>
</table>

Table 1—domestic animal dental formula. The number of each type of tooth on one side of the upper jaw (first number) and lower jaw (second number). To determine the total number of teeth, the number is then doubled.
Head – Teeth – Domestic

Table 1.2–domestic animal dental formula.
The number of each type of tooth on one side of the upper jaw (first number) and lower jaw (second number). To determine the total number of teeth, the number is then doubled.

<table>
<thead>
<tr>
<th></th>
<th>Incisor</th>
<th>Canine</th>
<th>Pre-molar</th>
<th>Molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse</td>
<td>3/3</td>
<td>1/1</td>
<td>3–4/3</td>
<td>3/3</td>
</tr>
<tr>
<td>Pig</td>
<td>3/3</td>
<td>1/1</td>
<td>4/4</td>
<td>3/3</td>
</tr>
<tr>
<td>Sheep</td>
<td>0/4</td>
<td>0/0</td>
<td>3/3</td>
<td>3/3</td>
</tr>
</tbody>
</table>

Large square teeth with a unique pattern of ridges. Complex folds in the molars - can be easily confused with human teeth. Teeth all very similar to cow but much smaller.
Strong canines with multi-ridged robust molars. Shape and size very similar to dog. Second pair of small incisors behind the front teeth.

Table 2.1—wild animal dental formula. The number of each type of tooth on one side of the upper jaw (first number) and lower jaw (second number). To determine the total number of teeth, the number is then doubled.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Incisor</th>
<th>Canine</th>
<th>Pre-molar</th>
<th>Molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badger</td>
<td>3/3</td>
<td>1/1</td>
<td>4/4</td>
<td>1/2</td>
</tr>
<tr>
<td>Fox</td>
<td>3/3</td>
<td>1/1</td>
<td>4/4</td>
<td>2/3</td>
</tr>
<tr>
<td>Rabbit</td>
<td>2/1</td>
<td>0/0</td>
<td>3/2</td>
<td>3/3</td>
</tr>
</tbody>
</table>
Grinding cheek teeth. Only roe and fallow deer in the UK have no upper canine.

A single row of teeth, each with a single point.

Lack of canines and orange tint to the front teeth.

Table 2.2—wild animal dental formula. The number of each type of tooth on one side of the upper jaw (first number) and lower jaw (second number). To determine the total number of teeth, the number is then doubled.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Incisor</th>
<th>Canine</th>
<th>Pre-molar</th>
<th>Molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roe deer</td>
<td>0/3</td>
<td>0-1/0</td>
<td>3/3</td>
<td>3/3</td>
</tr>
<tr>
<td>Seal</td>
<td>3/2</td>
<td>1/1</td>
<td>5/5</td>
<td>0/0</td>
</tr>
<tr>
<td>Squirrel</td>
<td>1/1</td>
<td>0/0</td>
<td>2/1</td>
<td>3/3</td>
</tr>
</tbody>
</table>
Forelimbs are the front legs of a mammal and are attached to the body by the scapula, or shoulder blade.

The basic pattern of the forelimbs is a flat triangular scapula attached to a single long humerus at the shoulder joint. The humerus, or arm bone, forms a hinge joint with the ulna and radius at the elbow joint.

Humans can move the ulna and radius to turn the hand over but many mammals cannot do this. Mammals that benefit from being able to rotate the hand have a separate ulna and radius, such as the cat, seal and squirrel. Other mammals which need greater strength in the forearm have fused these two bones together, this is true for most of the mammals with hooves. The shape and size of these bones can vary considerably to reflect the requirements of each animal. This is often reflected in characteristic bone extensions which allow for muscle attachments (processes) or smooth areas which allow the bones to move together, or articulate. For example, the forelimbs of both the badger and seal have evolved to accommodate large muscles for digging and swimming, respectively. Consequently, the bones in their forelimbs are robust with distinctive ridges for muscle attachment.
The humerus, or upper foreleg, is a long bone which attaches the scapula (shoulder bone) with the bones on the lower foreleg (radius and ulna).

The upper end of the bone has a hemispherical smooth surface where it joins the scapula at the shoulder joint. Around the smooth surface are a number of grooves and nobbles (tuberosities) for tendons and muscle attachments.

The shaft of the humerus can appear twisted because the muscle attachments. The elbow end looks like a clenched fist on one side and has a Y shape on the opposite side. In some mammals, for example cat, dog and fox, a small hole can be seen at the lower end.

**Cat**
- Oval hole to the side of the lower end of the bone.

**Cow**
- Large, robust bone with ridges along the shaft and a curved notch at the head.

**Dog**
- Circular hole through the centre of the lower end of the bone.

**Horse**
- Shaft is twisted with a large ridge.

**Pig**
- Large supinator ridge.

**Sheep**
- Large curved tuberosity on the upper end.
Forelimbs – Humerus – Wild

Badger: Relatively short, wide and chunky with a distinctive ridge and an oval hole to the side of the lower end of the bone.

Fox: Circular hole through the centre of the lower end of the bone.

Rabbit: Long, thin, smooth bone with a small tubercle at the upper end and a small hole at the lower end.

Roe deer: Large curved tubercle at top of the shaft.

Grey seal: Long, thin, smooth bone with a small tubercle at the upper end and a small hole at the lower end.

Squirrel: Small bone with twisted ridges along the shaft.
Forelimbs – Radius and ulna – Domestic

The radius and ulna are attached to the humerus at the elbow and extend down to the wrist. The radius is the main weight bearing bone and is wider but shorter than the ulna.

One end of the radius is circular, when viewed from the end, and this joins the humerus at the elbow. The other end is broader and oval and often has ridges running along it to keep the tendons in place. The ulna has a characteristic notch at the wider end which forms the hinge joint with the humerus. The ulna extends beyond the humerus to form the point of the elbow (olecranon) where the muscles attach; the shape of the olecranon is useful in identifying the species of the ulna.

In mammals where the ulna and radius are fused the pattern of fusion can be used to identify the species; some fusion is bony whilst in others it is by strong ligaments.

Cat

Horse (feral)

Cow

Pig (Berkshire)

Dog

Sheep (Texel)

Ulna and radius form a narrow joint at the elbow end and then separate. The lower 2/3 of the shaft they are completely fused with bone.

Separate ulna and radius.

Separate ulna and radius.

Separate short and thick ulna and radius.

Ulna and radius form a narrow joint at the elbow end and then separate. The lower 2/3 of the shaft they are completely fused with bone.

Ulna and radius form a narrow joint at the elbow end and then separate. The lower 2/3 of the shaft they are completely fused with ligament.

Ulna and radius form a narrow joint at the elbow end and then separate forming a characteristic hole. The ulna then completely fuses with the radius and in the lower half there is only a radius.

Separate ulna and radius.
Forelimbs – Radius and ulna – Wild

**Badger**
Ulna and radius relatively straight, short and broad.

**Fox**
Ulna and radius relatively straight, long and narrow.

**Rabbit**
Ulna and radius fused with ligaments so may come apart after death. Ulna and radius curved forwards.

**Roe deer**
Ulna and radius fused with ligaments so may come apart after death.

**Grey seal**
Radius with characteristic round end widening out to form a thick triangle. Ulna with characteristic notch for the humerus and a very large olecranon.

**Squirrel**
Ulna curved backwards and radius curved forwards.
Hind limbs are the back two legs of a mammal and are attached to the spine by the pelvis. The basic pattern of the hind limbs is the same as the forelimbs.

The femur, or thigh bone, attaches to the pelvis at the hip joint and at the lower end forms a hinge joint with the tibia at the knee. The fibula lies alongside the tibia.

The hind limb bones tend to be more robust than the equivalent forelimb bones.
The femur, or thigh bone, attaches to the pelvis at the top of the hind limb and runs down the thigh to the knee joint.

At the hip end of the bone there is a smooth ball attached to one side by a short neck, this fits into the socket on the pelvis. At the other end there are two smooth curved surfaces separated by a deep groove, this forms the knee joint by attaching to the tibia. The shaft of the femur is narrower than the ends of the bone and are generally smooth with a ridge running down the back. At the hip end there are a number of prominences which provide attachment for the powerful muscles around the hip.

Cat

Straight and regularly shaped.

Large prominence on the opposite side to the hip joint about 1/3 of the way down the shaft.

Horse (feral)

Very large trochanter which extends further than the round head with notches at the base.

Pig (Berkshire)

Small lesser trochanter.

Sheep (Texel)

Small ball head with an obtuse angle.
Hind limbs – Femur – Wild

Badger

Short, chunky and wasted in the middle. Large trochanter with ridge.

Fox

Long narrow shaft.

Rabbit

Straight relatively long shaft with a third prominence on the outside of the shaft at the level of the trochanter.

Roe deer

Obtuse angle at head of the bone with prominent notches in the end.

Grey seal

Short and wide.

Squirrel

Pronounced angular trochanters with a third prominence on the outside of the shaft below the level of the trochanter.
The tibia, or shin bone, and the fibula connect the knee (stifle) to the ankle (hock). In mammals which walk on their toes, which includes all six of these domestic mammals, the tibia and fibula are quite high up on the hind limb. In mammals which walk on their feet, like humans and rabbit, the tibia and fibula finish very close to the ground.

The tibia is the main weight bearing bone and is substantially bigger than the fibula. The tibia is usually triangular in cross section at the wider (knee) end of the bone, has a smooth surface on the shaft and a characteristic shape to the narrower end.

In some mammals the fibula is a long thin bone running parallel to the tibia but in others it has nearly disappeared leaving only a small bone on the outside of the ankle or a small splint running down from the knee.

- Cat: Both bones long and slender and approximately the same length.
- Cow: Tibia is large and broad with the fibula reduced to a small bone at the ankle.
- Dog: Both bones long and slender and approximately the same length.
- Horse (feral): Tibia is large and broad with a small splint running down from the knee for the fibula.
- Pig (Berkshire): Large and ridged tibia with a spoon shaped fibula.
- Sheep (Texel): Very similar to cow but proportionally smaller and less robust.
Hind limbs – Tibia and fibula – Wild

- Badger: The larger tibia has a triangular cross section at the wider end of the bone and is oval at the other. It is quite wide for its length with broad joint surfaces. This fibula is just slightly shorter and much thinner with bulbous ends.

- Fox: The tibia has a triangular cross section at the wider half of the bone and two deep groves on the narrow end. The fibular is just shorter and separate.

- Rabbit: The tibia has a triangular cross section at the wider half of the bone. The fibula fuses with the tibia about half way down.

- Roe deer: Long thin tibia with a triangular cross section at the wider end and two deep groves on the narrow end. The fibula is a small bone on the outside of the ankle only.

- Grey seal: The tibia and fibula are fused at the wide end of the ‘bone’ but are separate at the narrower end. The fibula is relatively straight and the tibia curved giving a characteristic gap between the bones.

- Squirrel: The tibia has a triangular cross section at the wider end of the bone and has a slight ‘s’ shape, the fibula is about the same length.
The vertebral column, or spine, of an animal is composed of several individual bones which connect the head and the tail. Individual vertebrae are commonly found but can be difficult to identify in isolation.

The spine supports the four limbs and the ribs, which protect the vital organs. Excluding the tail, the spine consists of four regions:

- **Cervical vertebrae**—the first seven bones that form the neck.
- **Thoracic vertebrae**—spine shaped bones to support muscles and attach to the rib bones.
- **Lumbar vertebrae**—angular bones which attach muscles to the hind limbs.
- **Sacral vertebrae**—bones of the pelvic region.

### Table 3
Domestic animal vertebrae formula showing the number of vertebrae in each segment of the spinal column.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Cervical</th>
<th>Thoracic</th>
<th>Lumbar</th>
<th>Sacral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat</td>
<td>7</td>
<td>13</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Cattle</td>
<td>7</td>
<td>13</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Dog</td>
<td>7</td>
<td>13</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Horse</td>
<td>7</td>
<td>18</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Pig</td>
<td>7</td>
<td>11-15</td>
<td>6-7</td>
<td>4</td>
</tr>
<tr>
<td>Sheep</td>
<td>7</td>
<td>13</td>
<td>6-7</td>
<td>3-4</td>
</tr>
</tbody>
</table>

### Table 4
Wild animal vertebrae formula showing the number of vertebrae in each segment of the spinal column.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Cervical</th>
<th>Thoracic</th>
<th>Lumbar</th>
<th>Sacral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badger</td>
<td>7</td>
<td>15</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Fox</td>
<td>7</td>
<td>13</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Rabbit</td>
<td>7</td>
<td>12</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Roe deer</td>
<td>7</td>
<td>13</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Seal</td>
<td>7</td>
<td>15</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Porpoise</td>
<td>7</td>
<td>12-16</td>
<td>33</td>
<td>0</td>
</tr>
</tbody>
</table>
The first two bones of the cervical region are the atlas and axis which sit immediately behind the skull.

The first of these, the atlas, is uniquely shaped with two large depressions which meet with two large bumps at the base of the skull.

The rear of the atlas pivots around the second vertebra, the axis, allowing the head to rotate.

On the head end of the axis is a projection, the odontoid peg, which lies inside the spinal canal of the atlas and acts as the pivot point.

The odontoid peg can take two forms; a cylindrical, round ended peg (eg. dog) or a ‘U’ shaped peg (eg. horse). When there is a ‘U’ shaped peg the atlas has a ‘U’ shaped joint surface to match. With a cylindrical peg there are two joint surfaces on the atlas, one on either side.

Domestic atlas comparison:

Domestic axis comparison:

Wild atlas comparison:

Wild axis comparison:
Spine – Vertebrae – Atlas and axis - Domestic

**Atlas**
- Round ring forming the spinal canal with a rounded transverse process and two smooth surfaces for the joint with the axis.

**Axis**
- Rectangular when seen from above with a single 'u' shaped smooth surface for the joint with the axis.
- Round ring forming the spinal canal with a rounded transverse process, which is more prominent than in a cat, and points slightly backwards. Two smooth surfaces for the joint with the axis.
- The odontoid peg is cylindrical. The back end of the spinous process ends at a point with a notch separating it from the articular facets to the side.
- The odontoid peg is 'U' shaped when viewed from the end. The spinous process is a single ridge (compare with the horse).
- The odontoid peg is cylindrical. The back end of the spinous process ends at the same level as the articular facets (compare with badger and cat).
Almost bow tie shaped when viewed from above with two holes on each side. A single 'U' shaped smooth surface for the joint with the axis.

Rectangular when seen from above with three smooth surfaces for the joint with the axis.

Rectangular when seen from above with a single 'U' shaped smooth surface for the joint with the axis.

The odontoid peg is 'U' shaped when viewed from the end. The spinous process is low and single at the head end but divides into two to form a 'Y'.

The odontoid peg is cylindrical and broad and the spinous process wide and tall.

The odontoid peg is 'U' shaped when viewed from the end. The spinous process is a single ridge.
Spine – Vertebrae – Atlas and axis – Wild

- **Atlas**
  - Fox
  - Rabbit
  - Badger

  *Round ring forming the spinal canal with almost a hemi-circle transverse process. Two smooth surfaces for the joint with the axis.*

  *Round ring forming the spinal canal with a rounded transverse process pointing slightly backwards. Two smooth surfaces for the joint with the axis.*

  *Round ring forming the spinal canal with a rounded transverse process curling forwards. Two smooth surfaces for the joint with the axis.*

- **Axis**
  - Fox
  - Rabbit
  - Badger

  *The odontoid peg is cylindrical. The back end of the spinous process ends as a ‘fin’ with a deep notch separating it from the articular facets to the side.*

  *The odontoid peg is cylindrical. The back end of the spinous process ends at the same level as the articular facets (compare with badger and cat).*

  *The odontoid peg is cylindrical. The spinous process has a curved upper edge.*
Spine – Vertebrae – Atlas and axis – Wild

Rectangular when seen from above with the ends of the transverse processes almost straight and parallel. A single ‘U’ shaped smooth surface for the joint with the axis.

Round ring forming the spinal canal with a bulky transverse process and two smooth surfaces for the joint with the axis.

The first six cervical vertebrae are fused together to form a single bone. The overall shape is characteristic.

The odontoid peg is ‘U’ shaped when viewed from the end. The spinous process is broad and ends at a point.

The odontoid peg is cylindrical and broad. The spinous process is tall and broad with a rounded upper edge and ‘hanging over’ each end.

The first six cervical vertebrae are fused together to form a single bone. The overall shape is characteristic.
All British mammals have seven vertebrae in the cervical region (neck). The first vertebra, the atlas, and the second vertebra, the axis, have distinctive features which enable them to fulfill specialist functions. The remaining five cervical vertebrae are similar to each other.

All cervical vertebrae have three holes; a large central canal for the spinal cord, and two smaller holes (foramina) each side for the vertebral arteries; thoracic and lumbar vertebrae do not have these two smaller foramina. Looking from the end of the 5 typical cervical vertebrae they are approximately square, the width and height of the vertebrae are about the same; thoracic are often taller than wide and lumbar wider than tall.

Domestic cervical comparison:

Wild cervical comparison:
**Cat**

Wider than it is long with the spinous process coming to a point and angled forwards. The lower process on the vertebral body has a notch.

**Cow**

Large and overall slightly wider than it is long. The spinous process is well formed with a ‘bobble’ on the end.

**Dog**

Almost square when seen from above with a very short spinous process. The lower process on the vertebral body has a straight lower edge.

**Horse (feral)**

Almost square when seen from above with a very short spinous process.

**Pig (Berkshire)**

Large and overall longer than it is wide with the spinous process reduced a ridge on the top. The vertebral body ends are shaped like a ball on the body end and a socket on the head end.

**Sheep (Texel)**

Wider than it is long with the spinous process coming to a point and angled forwards. The lower process on the vertebral body is rounded.

**Wider than it is long with the spinous process coming to a point and angled forwards. The lower process on the vertebral body is rounded.**
Spinous process about the same height as the spinal canal. Double transverse process on the body. Marginally wider than it is long.

Spinous process about the same height as the spinal canal. Double transverse process on the body. Almost square from above.

Short spinous process, canal for spinal cord oval. Double transverse process on the body. Much wider than it is long.

Spinous process about the same height as the spinal canal. Single transverse process on the body. Longer than it is wide.

Short spinous process and double transverse process on the body. Wider than it is long.

The first six cervical vertebrae are fused together to form a single bone (shown for the atlas and axis). The seventh cervical vertebra is separate with a wafer thin body.
The thoracic region contains the bones in the upper part of the spinal column below the neck and have smooth facets on either side to support a pair of ribs and a spinous process pointing upwards and backwards. The body is typically heart shaped.

The number of thoracic vertebra in mammals varies greatly from as few as 9 to 25, though 12 to 15 is common in most mammals.

Domestic thoracic lateral comparison:  

Wild thoracic lateral comparison:  
a–grey seal, b–porpoise, c–roe deer, d–badger, e–fox, f–rabbit.
Tapering spinous process.

Long spinous process compared with the body with an equal width all the way along.

Spinous process with a kink.

Very long spinous process for the size of the body with a slight taper towards the end; narrower compared with a cow.

Spine process equally broad all the way along. Transverse process towards the back of the body.

Spine process equally broad all the way along. Transverse process level with the centre of the body.
Spine – Vertebrae – Thoracic – Wild

- **Badger**: Spinous process broad.
- **Fox**: Spinous process with a kink.
- **Rabbit**: Very narrow spinous process with a ‘bobble’ on the tip.
- **Roe deer**: Spinous process with a slight taper.
- **Grey seal**: Short, narrow and thick spinous process. Prominent attachments for the ribs.
- **Porpoise**: Short broad spinous process. Almost round body and prominent attachments for ribs.
The lumbar vertebrae start at the back of the ribcage and finish at the sacrum. They characteristically have three projections: a central spinous process pointing upwards and two transverse processes coming out of each side. The body is typically kidney bean shaped.

The bodies of the lumbar vertebrae are bigger than in the other regions of the spine and the joints which connect them stop rotation. Although there are fewer lumbar vertebrae than thoracic the length of these parts of the spine may be similar because of the greater length of each vertebra in the lumbar region.

Domestic lumbar comparison:
a–horse, b–cow, c–pig, d–sheep, e–cat, f–dog

Wild lumbar comparison:
a–grey seal, b–porpoise, c–roe deer, d–badger, e–fox, f–rabbit.
Spine – Vertebrae – Lumbar – Domestic

- **Cat**
  - Transverse processes coming off the lower part of the body and pointing forwards and downwards. Spinous process pointing forwards.

- **Cow**
  - Transverse processes coming off the top of the body and pointing outwards, slightly upwards with a slight curve. Spinous process broader than tall.

- **Dog**
  - Transverse processes coming off the lower part of the body and pointing forwards and downwards. Spinous process pointing forwards.

- **Horse (feral)**
  - Transverse processes coming off just above the body and pointing outwards, horizontally and straight. Spinous process taller than broad.

- **Pig (Berkshire)**
  - Transverse processes coming off just above the body and pointing outwards with a narrower base and a wider rounded end. Spinous process tall and broad.

- **Sheep (Texel)**
  - Transverse processes coming off the top of the body and pointing outwards almost horizontally with a narrower base and wider angled end. Equally short and broad spinous process.
Transverse processes coming off the lower part of the body and pointing outwards and downwards. Spinous process pointing forwards.

Transverse processes coming off the lower part of the body and pointing forwards and downwards. Spinous process pointing forwards.

Transverse processes coming off the lower part of the body and pointing forwards and downwards with a wider triangular end.

Transverse processes coming off the lower part of the body and pointing forwards and downwards. Spinous process broad with a curve.

Transverse processes coming off the middle part of the body and pointing slightly forwards and downwards. Short spinous process pointing backwards.

Long transverse processes coming off the middle part of the body and pointing outwards, horizontally. Long spinous process pointing upwards with a triangular hole for the spinal cord.
The sacral vertebrae lie at the base of the spine, before the tail and support the pelvic region. They can vary in number as the vertebrae are often fused into one solid bone called the sacrum.

Domestic sacrum comparison:
a–horse, b–cow, c–pig, d–sheep, e–cat, f–dog

Wild sacrum comparison:
a–grey seal, b–roe deer, c–badger, d–fox, e–rabbit.
Cat

Longer than it is wide with three fused vertebrae. Prominent processes on the sides of the narrower end for tail muscles.

Cow

'T' shaped with massive connections for the pelvis. Last three vertebrae are the same width and the spinous processes are fused.

Dog

As broad as it is long with three fused vertebrae. Prominent processes on the sides of the narrower end for tail muscles.

Horse (Feral)

'T' shaped with massive connections for the pelvis. Last four vertebrae gradually taper and the spinous processes are separate.

Pig (Berkshire)

Four vertebrae becoming progressively narrower with a smooth curve. Very reduced spinous processes.

Sheep (Texel)

Broad first vertebra with robust connection for the pelvis. Other two vertebrae of equal width with fused spinous processes.
As broad as it is long with three fused vertebrae. Small process on the sides of the narrower end for tail muscles compared with fox, dog and cat.

As broad as it is long with three fused vertebrae. Prominent processes on the sides of the narrower end for tail muscles.

The first vertebra is broad for attachment of the lumbar vertebra and pelvis. The other three vertebra are very slender. The spinous processes get progressively shorter and the whole sacrum is gently curved.

Four vertebrae becoming progressively narrower with a smooth curve. Prominent spinous processes.

‘T’ shaped with short projections for the pelvis. The body is the same width most of the way down and quite broad and the spinous processes are short.
The scapula, or shoulder blade, is a distinctive, flat bone connected to the head of the humerus via the shoulder socket called the glenoid. The bone is commonly triangular and includes a distinctive spine down the middle of the bone for muscle attachment. The shape of the bone and location of the spine can vary depending on the type and function of the muscles attached.

For example, horses and deer have a triangular blade with a prominent central ridge to aid the attachment of weight-bearing muscles needed for running and jumping, whereas a seal’s shoulder blade is circular and more suited to support the muscles required to swim.

At the base of scapula is the glenoid cavity which articulates with the head of the humerus. This socket often contains a distinctive hook (coracoid process) which acts as a muscle attachment.

Domestic scapula comparison:

Wild scapula comparison:

Domestic glenoid comparison:

Wild glenoid comparison:
Body – Scapula and glenoid – Domestic

Curved leading edge with a straight back edge. Spine centrally located with a distinctive point on the ridge.

Cow: Spine located near the cranial edge.

Dog: Curved leading edge and straight back edge with a centrally placed spine.

Cat: Coracoid process is sharply hooked.

Cow: Short coracoid process.
Body – Scapula and glenoid – Domestic

Large triangular bone with a strong, prominent spine.

Spine folded over and central to the blade. Sharp pointed angle.

Small coracoid process swelling.

Small coracoid process swelling.

Short and slightly curved coracoid process.
Body – Scapula and glenoid – Wild

Badger

Scapula blade is distinctly rectangular.

Fox

Curved leading edge with a straight back edge. Spine centrally located. Coracoid process is rounded.

Rabbit

Long and narrow blade with straight sides. Spine closer to the short edge and folded over at the top. Coracoid process has a distinctive hook.
Body – Scapula and glenoid – Wild

**Roe Deer**

- Triangular with straight edges and a spine close to one edge, cranial edge more rounded.

**Grey Seal**

- Comma shaped, circular blade to support muscles for swimming. Small spine located centrally.

- 'D' shaped blade, spine includes an extra ridge on the base of the bone (acromion).

**Squirrel**

- Coracoid process short and curved.

- Glenoid is circular without a coracoid process.

- Long curved coracoid process.
The pelvis is the connection between the sacrum at the base of the spinal column and the hind limbs (femur) at the hip joints.

The shape of the pelvis varies between animals and reflects how the animal moves and the amount of weight that the pelvis needs to support. The shape also differs between sexes, with a broader pelvis in females.

The pelvis is made up of two halves, each containing three fused bones: the ilium, ischium and pubis bones. In some animals the two halves of the pelvis are fused together as a single bone. In other animals they remain separate and often only one half of the pelvis is found.


The two halves are fused together and overall the pelvis is of equal width along its length.

The two halves are commonly fused together and the fused end is as wide as the sockets for the femurs, it then becomes very wide at the end attaching to the sacrum. There are two prominences on the narrow end each side (more pronounced on sheep).

The two halves are fused together and overall the pelvis is of equal width along its length. The muscle attachment points are more prominent than on a cat.

The two halves are commonly fused together and the fused end is narrower than the width at the sockets for the femurs, it then becomes very wide at the end attaching to the sacrum. There is a single prominence on the narrow end each side.

Overall the pelvis tapers evenly along its length; the socket for the femur and the two prominences on either end are in a straight line. There are two prominences on the narrow end each side.

The two halves are commonly fused together and the fused end is as wide as the sockets for the femurs, it then becomes a little wider at the end attaching to the sacrum. There are two prominences on the narrow end each side.
The two halves are often separate with the point that they are in contact and the end of the pelvis being a continuous curve. The socket is large for the size of the pelvis.

The two halves are fused together and overall the pelvis is slightly wider at the fused end.

The two halves are commonly fused together and the fused end is as wide as the sockets for the femurs; it then becomes slightly wider at the end attaching to the sacrum. The fused ends form a distinct ‘W’.

The two halves are often fused together and overall the pelvis is of equal width along its length. The fused ends are rounded with a prominence pointing outwards.

The two halves are separate and the socket for the hip joint is much closer to the end attaching to the sacrum.

The two halves do not fuse. The bones of the ring are narrow with a large hole.
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