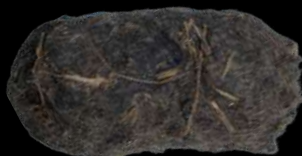




A Photographic Guide to Small Mammal Bones in Barn Owl Pellets

By Susanna J Ramsey & Derek Crawley





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Field vole

Introduction

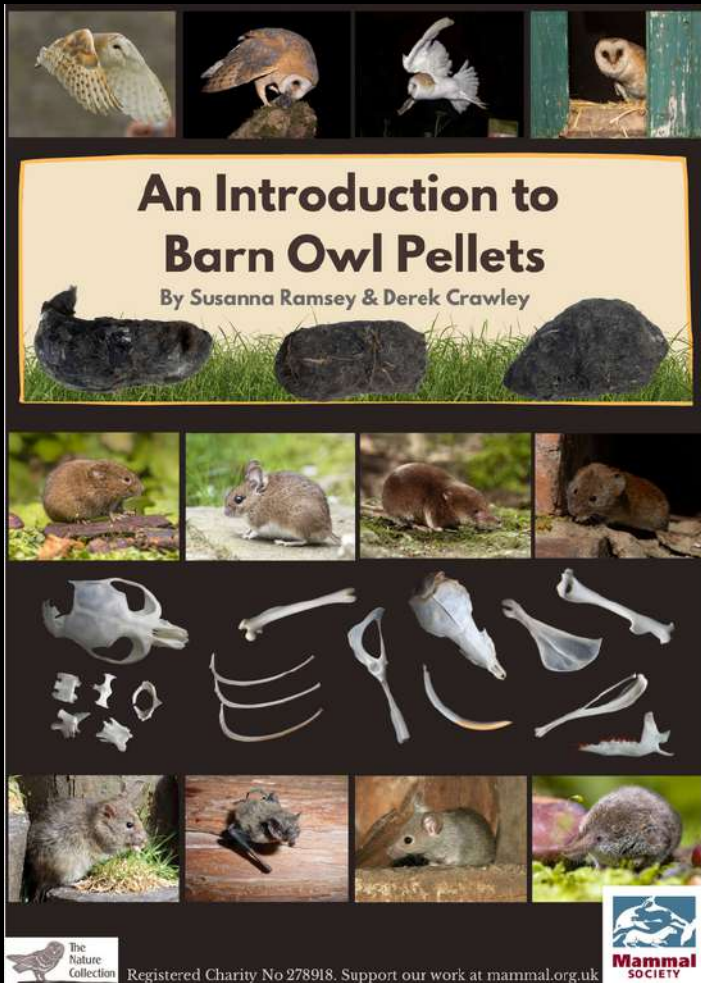


Common shrew

Owls swallow their prey whole then, several hours later, cough up the bones and fur, the indigestible parts, in the form of pellets. The pellets can be found under a roost site or scattered on the ground.

For most species of owl and birds of prey, the digestive juices are very acidic and break the bones down into smaller pieces. Barn owls have a milder digestion and the tiny bones usually emerge complete, or certainly identifiable, when they are coughed up in pellets. You can even pick out the preys' ribs, vertebrae and teeth, though they may be less than 1mm wide!

Importantly, this means that by examining the contents of barn owl pellets, it is possible to identify what the owls have been eating. This is useful for monitoring which small mammals are in an area, how the small mammal population changes over time and how it is affected by habitat loss or creation.



Analysing barn owl pellets is fun and absorbing and can be enjoyed by people of all ages. Children love it and often take apart pellets in schools, building memories which last into adulthood.

The Mammal Society has created an Introduction to Barn Owl Pellets, which is useful for the beginner. It is available to download for free, on the Mammal Society website. Take a look **if** you are new to pellet analysis and/or want to do this activity with children.



Wood mouse



Brown rat

Introduction



House mouse

This photographic guide is intended for the more serious mammalogist, who wants to identify the remains of voles or mice or shrews, down to species level. This is possible by looking through a magnifying glass or microscope at the skulls, jawbones, teeth and tooth root holes.

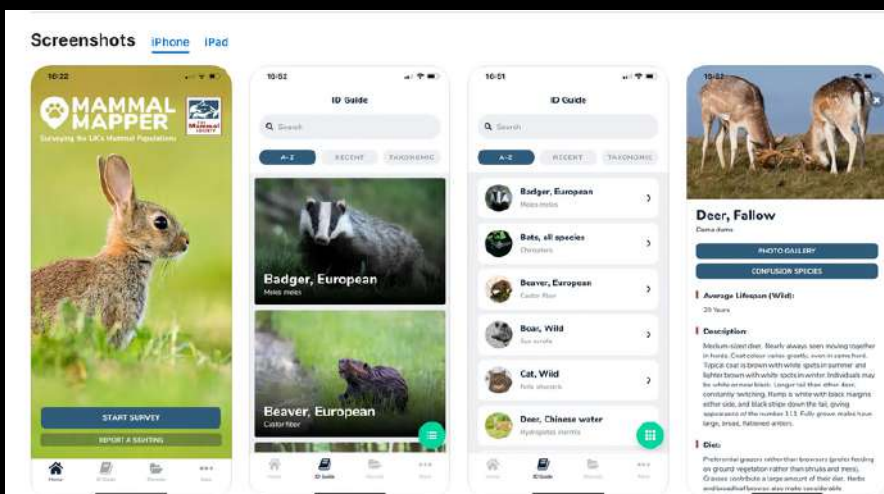
The bones in the pellets are tiny, usually less than 15mm long. Many have been photographed by Susanna Ramsey, through a microscope at a magnification of 20-40 times. The key, identifying features have been highlighted in red text.

The most common bones in barn owl pellets are from field voles, wood mice and common shrews. There may also be bones from bank voles, water voles, common voles, house mice, harvest mice, yellow-necked mice, brown rats, pygmy shrews, water shrews, greater and lesser white-toothed shrews. The common vole and white-toothed shrews only occur naturally in limited areas of the UK, often restricted to specific islands.

As well as small mammals, barn owls sometimes take young rabbits, bats, dormice, moles and weasels. They catch other, smaller birds such as starlings and song thrush. Sometimes they eat caterpillars, earthworms, beetles, frogs, toads and fish.

This guide aims to help with the identification of voles, mice and shrews to species level. It also contains photos of the other possible prey items.

When you have analysed the pellets, please share what you have found with the Mammal Society, through the [Mammal Mapper App](#).





Rodents



Most rodents have 4 teeth on each side in the upper and lower jaw. They have 1 sharp, cutting incisor at the front and 3 cheek teeth, or molars, for grinding food. Squirrels and dormice are the exception having 4 cheek teeth.

The dental formula for voles, mice and rats is $1,0,0,3/1,0,0,3 = 16$. For squirrels and dormice, it is $1,0,0,4/1,0,0,4 = 20$. (Dormice occasionally found in pellets.) See the Glossary on Page 42 for an explanation of the dental formula.

Wood mouse jawbone



Rodents have very large incisors, which are coated on the front surface with orange enamel. This makes the front of the tooth tougher than the back, so the tip wears down to a sharp, chisel-like blade. Rodents' incisors never stop growing. All rodents' teeth have open roots.

Brown rat skull



Between the incisor and cheek teeth, rodents have a large gap called the 'diastema'. They can suck the inside of their cheeks into this gap to prevent food going down their throat before they are ready to swallow. This is useful when they are gnawing at tough roots or collecting food.

Voles



All species of vole have 4 teeth on each side in the upper and lower jaw. They have 1 incisor and 3 cheek teeth, or molars, for grinding food. All voles are herbivores, eating only plants.

The large incisors are curved and orange at the front.

The cheek teeth are flat and thin. They have vertical ridges and furrows on the sides. They look striped. When viewed from above, the outline of a field vole's cheek teeth is a zigzag. For bank voles, the outline is looped.

The most common bones found in owl pellets are from field voles. We also find evidence of bank voles, who are a similar size and the larger bones from water voles. On Orkney & Guernsey, the only voles present are common voles. They have very similar skulls and teeth to field voles.



Field vole



Bank vole

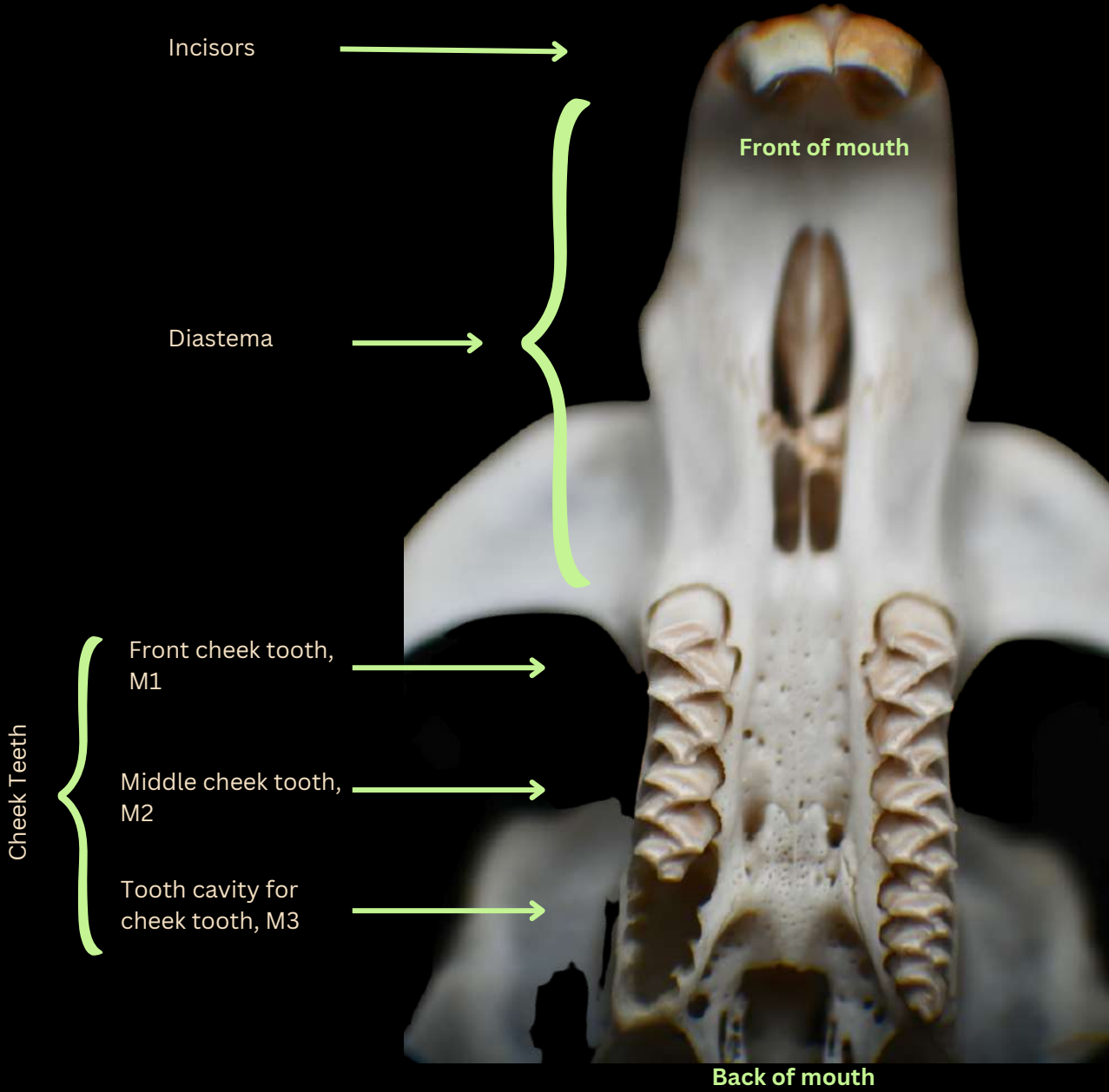


Water vole

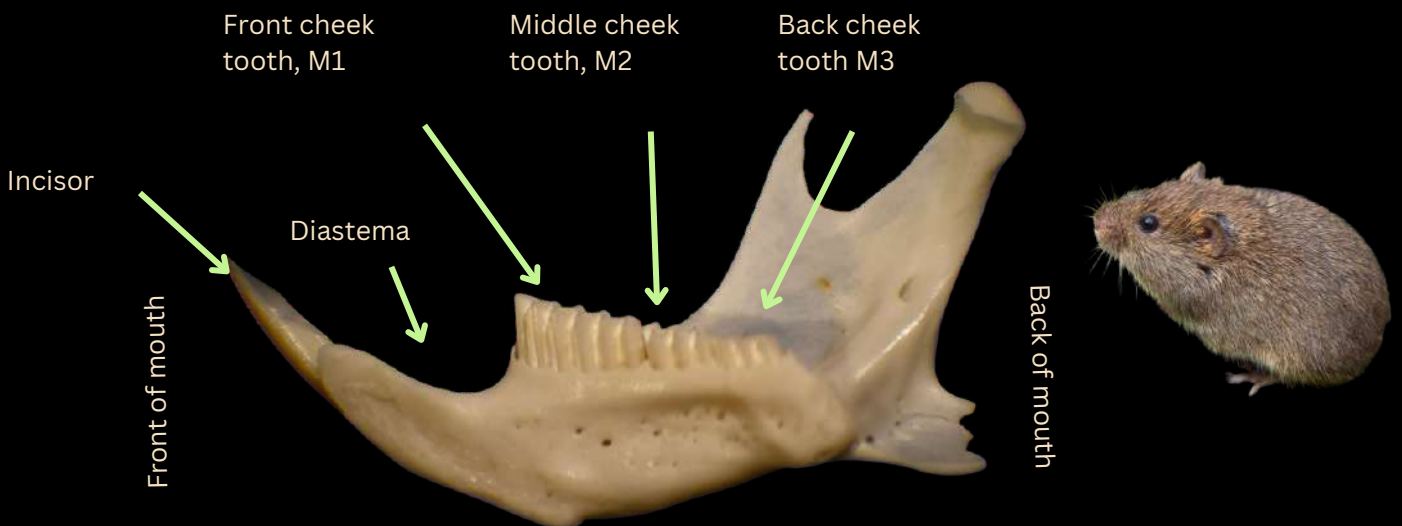




Underside of a Field Vole Skull



Field Vole Jawbone





Field Vole

Microtus agrestis

Most common prey of barn owls.

The field vole is also known as the short-tailed vole or short-tailed field mouse.

Teeth

- Outline of the cheek teeth is angular zigzags, (Pic 6)
- Cheek teeth have ridges and furrows all the way down the sides, (Pics 2 & 4)
- **Middle cheek tooth, M2, in the upper jaw has an extra loop on the inner edge**, next to the back tooth, M3, (Pics 6 & 8)
- Length of upper cheek teeth row is 5.8 - 7mm, (Pic 6)

Roots

- **Upper & lower jaw have 3 scallop-edged tooth cavities on each side**, (Pic 7)
- Cheek teeth have no roots, (Pic 4)

Skull

Skull is 25.2mm long (females), 26.1mm long (males), (Pic 1)



1. Skull



2. Cheek teeth in skull



3. Upper incisors



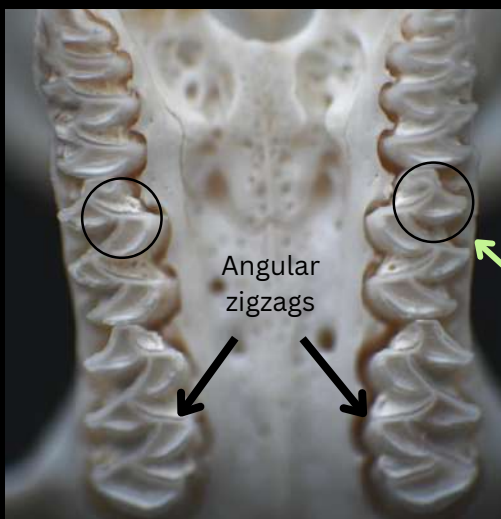
4. Cheek teeth



5. Jawbone



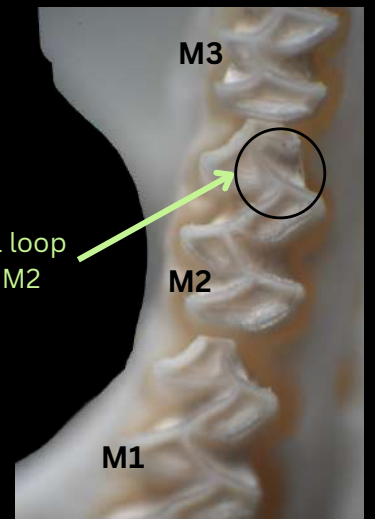
6. Cheek teeth in skull



7. Tooth cavities in skull



8. Cheek teeth in skull





Bank Vole

Myodes glareolus

The bank vole is also known as *Clethrionomys glareolus*.

Teeth

- Incisors are narrower and weaker than for field vole,
- **Outline of cheek teeth is rounded, looped zigzags**, (Pics 4 & 6)
- Cheek teeth have vertical ridges and furrows but not all the way down the tooth, (Pic 3)
- **Middle tooth, M2, in upper jaw has no extra loop on inner edge**, (Pic 6)
- Length of upper cheek tooth row length: 5.0 -6.4mm, (Pics 4 & 5)

Roots

- Each cheek tooth in upper and lower jaw has 2 roots, (Pic 3)
- **Upper and lower jaws have 6 round, separate, root holes**, (Pics 2 & 5)
- **Cheek teeth develop 2 roots each, with age**. Initially they have none, (Pic 3)

Skull

- Skull is 22.1mm long
- Auditory bullae, (ear casings), are large and inflated

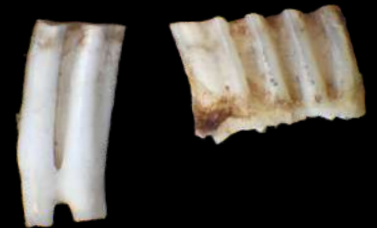
1. Jawbone



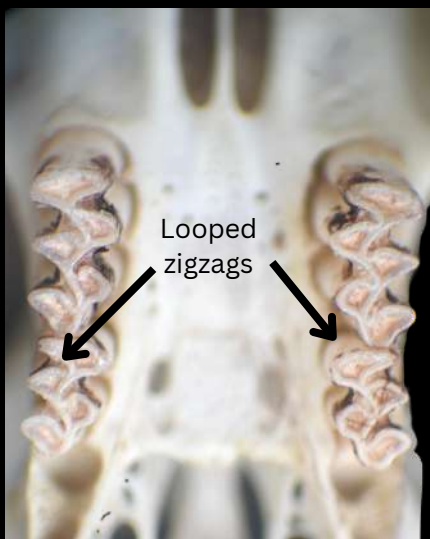
2. Six root holes in jawbone



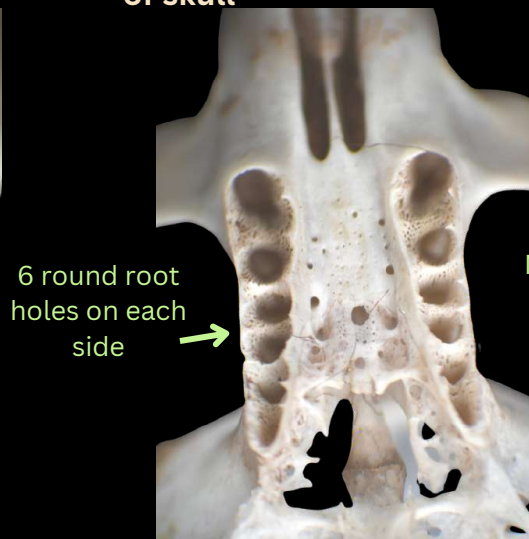
3. Cheek teeth



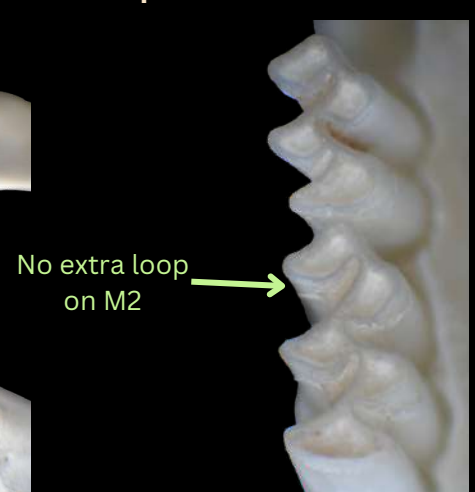
4. Cheek teeth in skull



5. Six root holes in underside of skull



6. Rounded, looped profile to cheek teeth





Water Vole *Arvicola amphibius*

Rare in owl pellets.

Skull and jawbones are similar to those of the field vole but much larger.

Teeth

- Outline of cheek teeth is **angular zigzags, very narrow in places**, (Pics 4 & 6)
- Cheek teeth have ridges and furrows all the way down the tooth, (Inset)
- **No extra loop on middle molar, M2, upper jaw**, next to M3, (Pic 6)
- Length of upper cheek teeth row: 8.5 - 11.0mm, (Pic 5)



Broken incisors

Roots

- Cheek teeth have no roots, (Inset)
- **Upper and lower jaw have 3 scallop-edged tooth cavities, on each side**, like the field vole, (Pics 1, 4 & 5)

Skull

- **Skull is over 32mm long**, (Pic 4)



Cheek teeth



1. Tooth cavities in jawbone



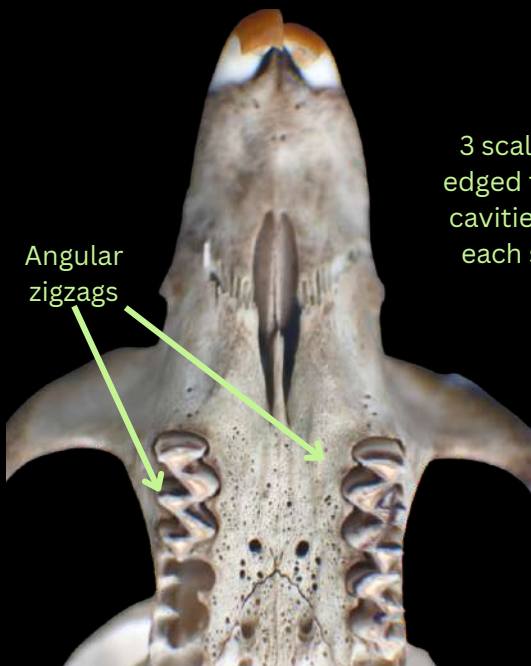
2. Jawbone



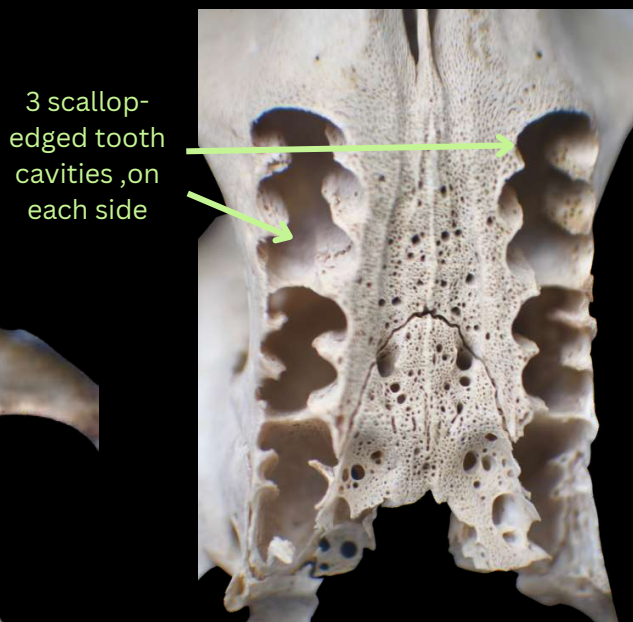
3. Upper incisor



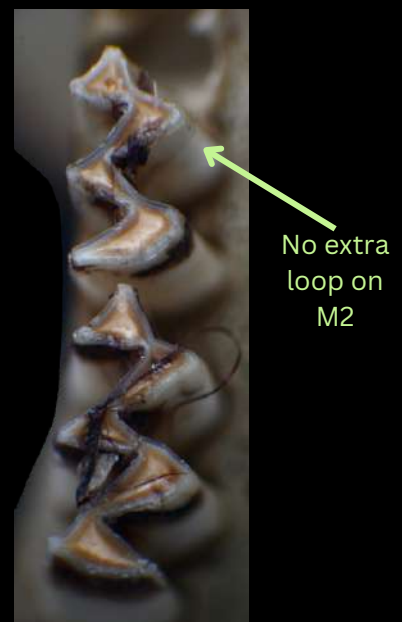
4. Underside of skull



5. Cheek teeth cavities in skull



6. Angular, thin profile to cheek teeth





Common Vole

Microtus arvalis



There are no bank voles on Orkney or Guernsey, but the common vole is present. Common voles have a similar skull, teeth and root holes to the field vole.

Teeth

- Outline of cheek teeth is angular zigzags, (Pics 2 & 4)
- Cheek teeth have ridges and furrows all the way down the tooth. Appear striped. (Pic 1)
- **M2, in upper jaw has no extra loop on inner side**, next to M3, (Pic 4)

Roots

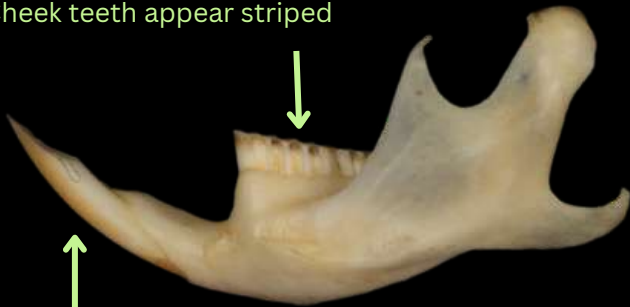
- No roots to cheek teeth
- **Upper and lower jaw have 3 scallop-edged tooth cavities, on each side**, (Pics 2 & 5)

Skull

- Skull is 24 -30mm long

1. Jawbone, with teeth *

Cheek teeth appear striped



Incisor face, coated in orange enamel

2. Jawbone, with teeth and root hole *

Scallop-edged tooth cavity



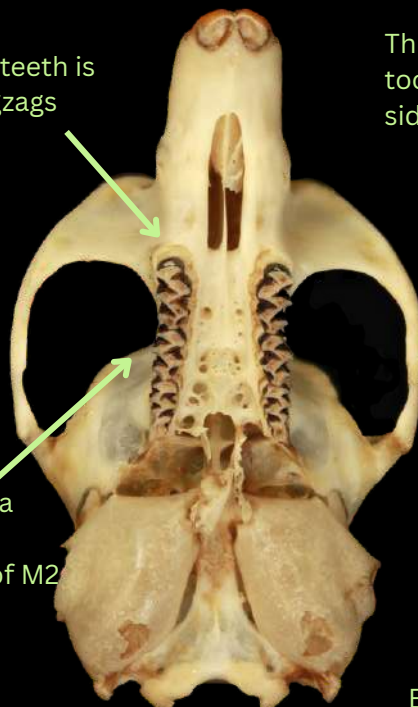
3. Skull, from above *



4. Underside of skull, with teeth *

Outline of teeth is angular zigzags

No extra loop on inside of M2



5. Underside of skull, with root holes *

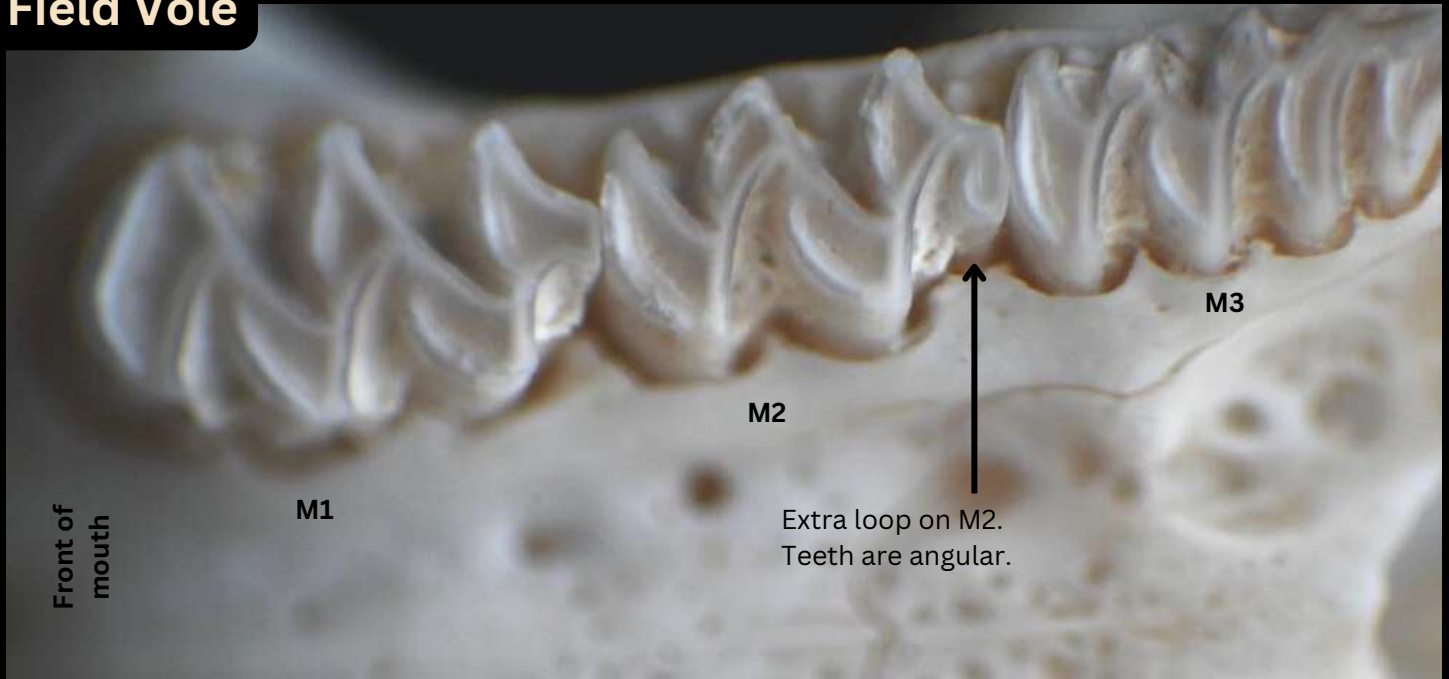
Three scallop-edged tooth cavities, on each side

Ear cavity

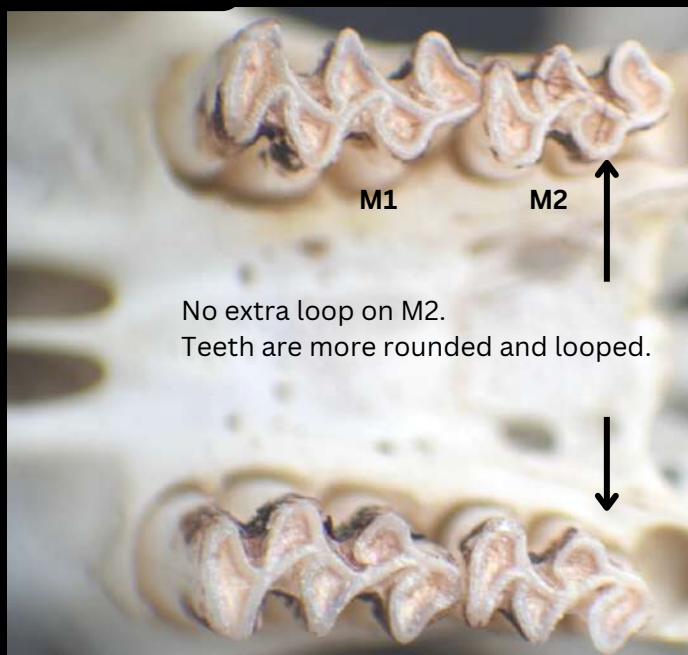


Comparing Voles' Upper Cheek Teeth

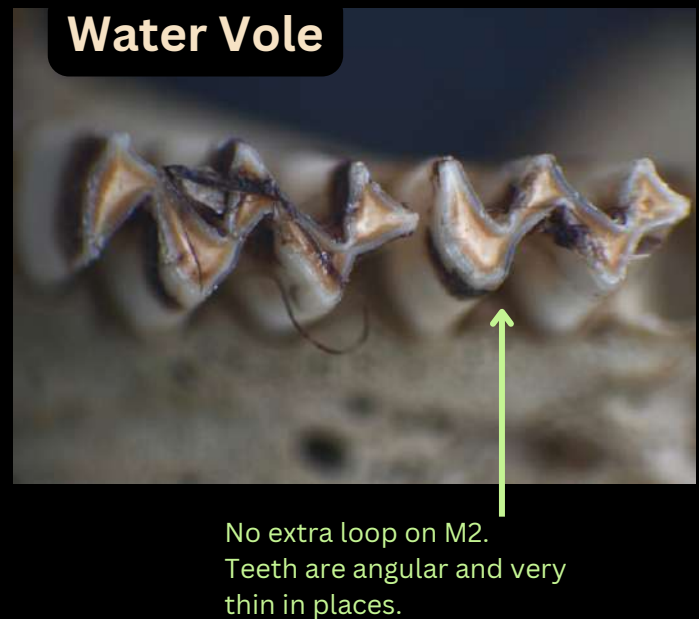
Field Vole



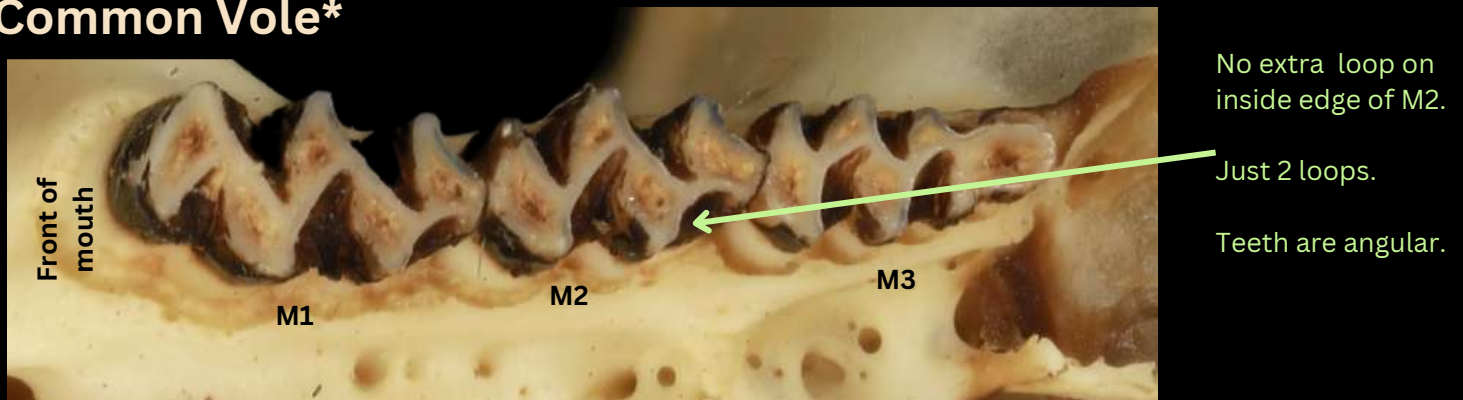
Bank Vole



Water Vole

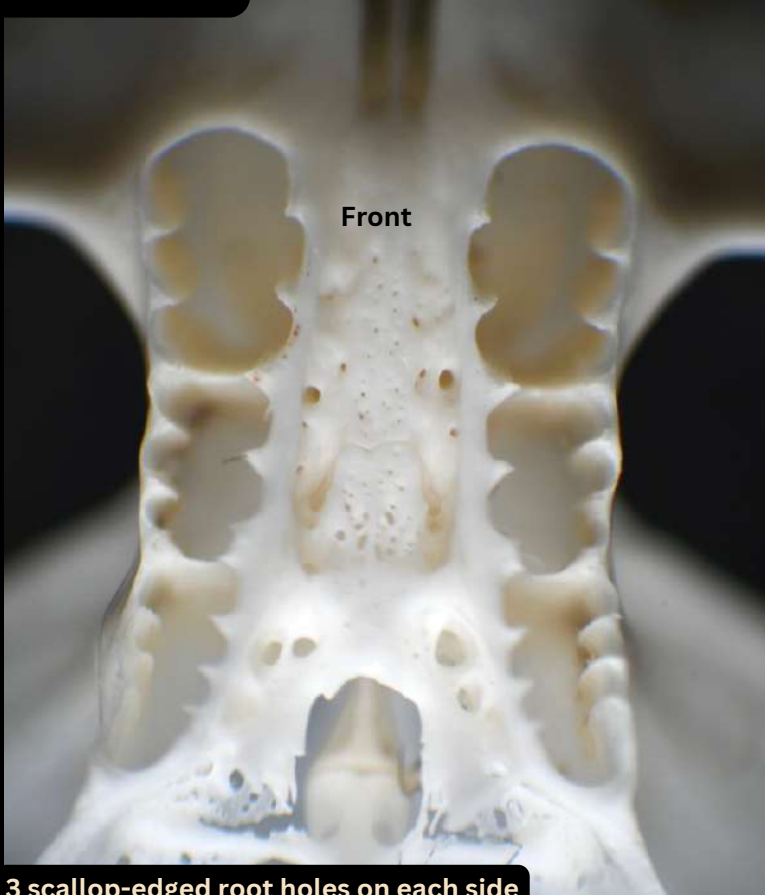


Common Vole*

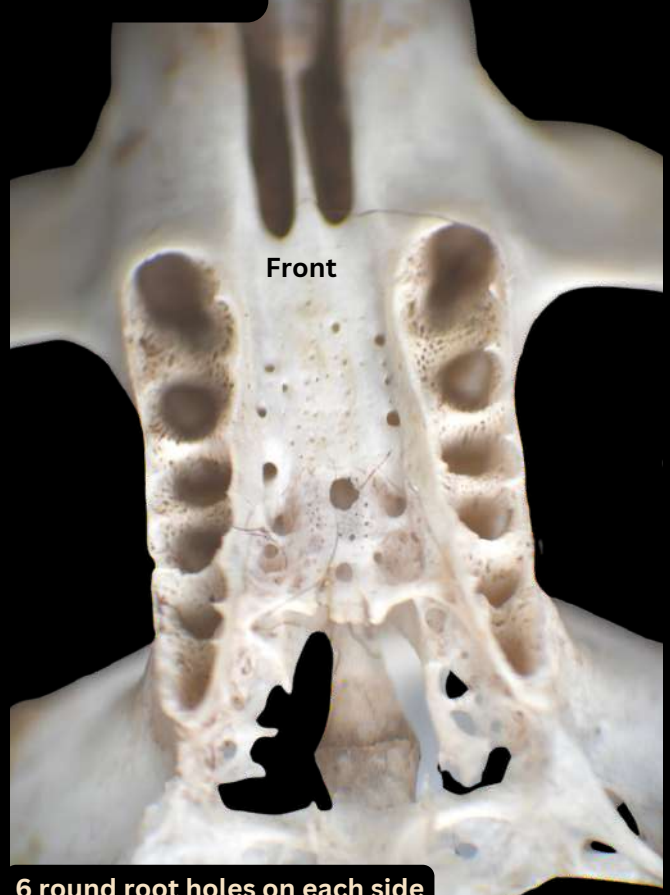


Comparing Voles' Root Holes in Skull

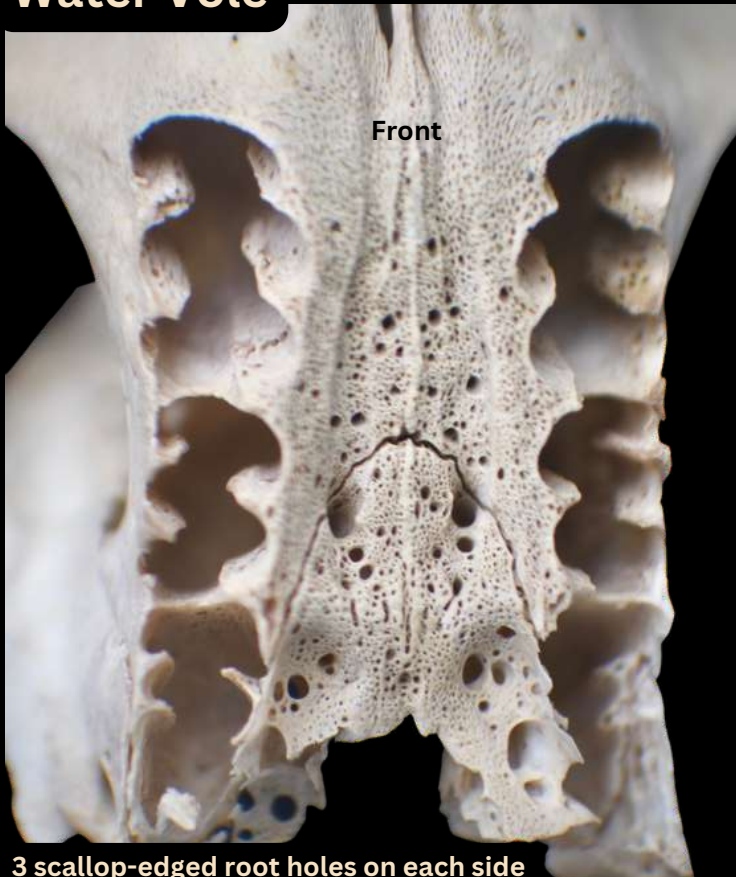
Field Vole



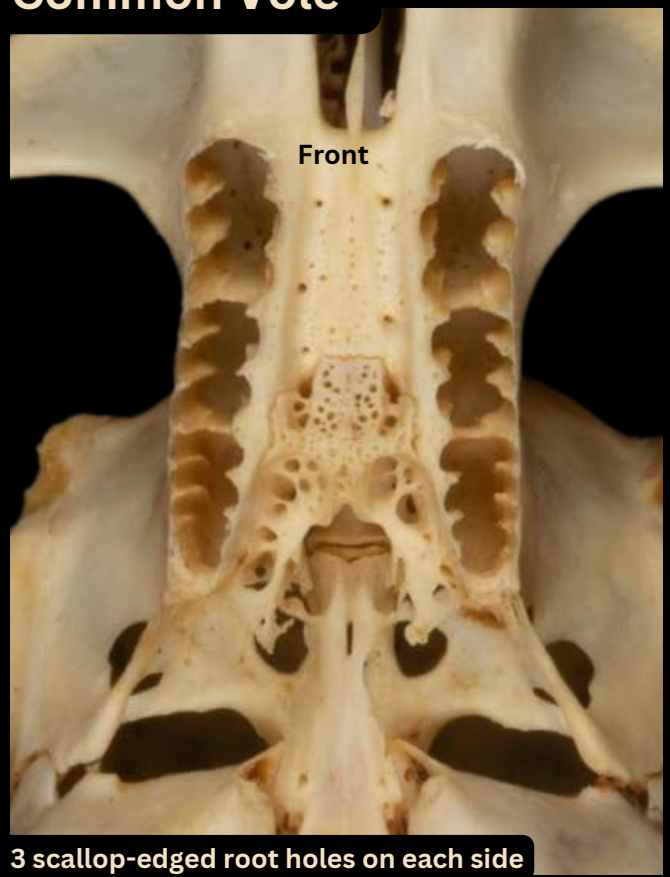
Bank Vole



Water Vole



Common Vole*



Mice & Rats



All species of mouse and rat have 4 teeth on each side in the upper and lower jaw. They have 1 sharp, cutting incisor and 3 cheek teeth for grinding. They are all omnivores, eating mainly invertebrates and plants.

The large incisors are curved and orange at the front. Notches on the back of the incisor are diagnostic.



The cheek teeth, the molars, have a rounded, knobby surface. They have cusps on the edges. The front cheek teeth are always the largest in both the upper and lower jaws.

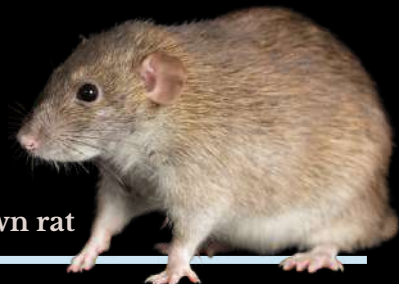
Cheek teeth have roots which leave separate, round holes in the skull and jawbone. The number and pattern of the root holes helps to identify the species. The second most common bones found in owl pellets are from wood mice. We also find bones from house mice and harvest mice, who are both smaller. Brown rats are much larger. Black rat bones are very rare in pellets.



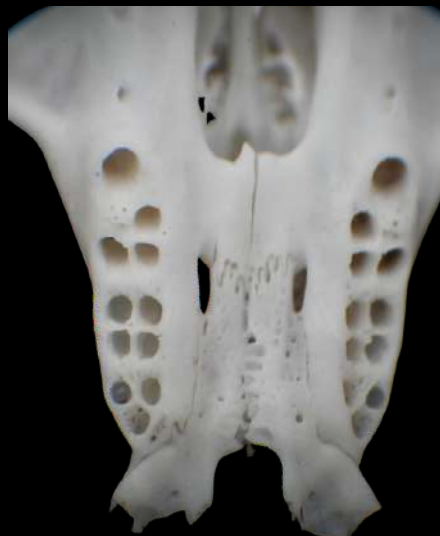
Wood mouse



Harvest mouse



Brown rat



Underside of a Wood Mouse Skull



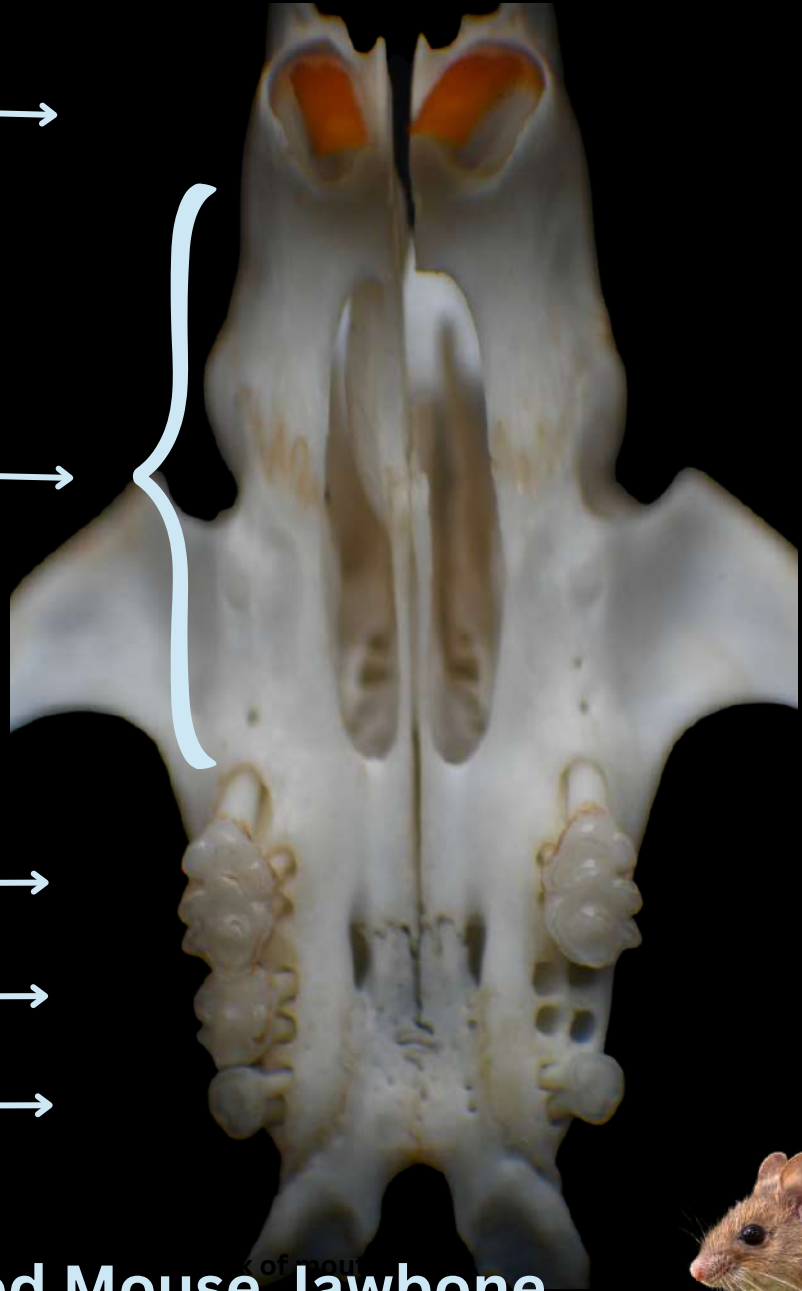
Incisor



Diastema



Front



Cheek Teeth

Front cheek tooth, M1



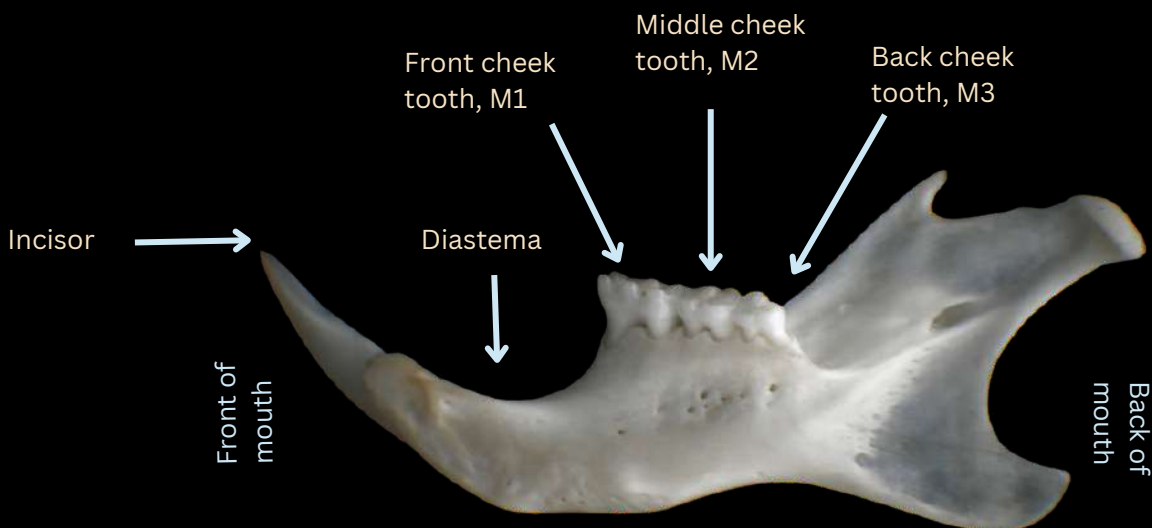
Middle cheek tooth, M2



Back cheek tooth, M3



Wood Mouse Jawbone





Wood Mouse

Apodemus sylvaticus

Wood mice are the second most common prey of barn owls. They are also known as long-tailed field mice.

Hard to differentiate between smaller wood mouse and larger yellow-necked mouse

Teeth

- No notch on the inside edge of the incisors, (*Pic 4*)
- M1 and M2 in upper jaw have 3 cusps on the inner edge, (*Pic 7*)
- Front cheek tooth in lower jaw, M1, has 3 cusps at the front, (*Pic 3*)
- Length of upper cheek teeth 3.6 - 4.2mm



Cheek tooth

Roots

- **Upper jaw, 11 root holes.** M1 has 4 roots, M2 has 4 roots and M3 has 3, so $4+4+3=11$, (*Pic 5*)
- **Lower jaw, 6 round, root holes,** (*Pic 2*)
- **Length of lower jaw is 16mm or less,** (*Pic 1*)

Skull

- **Skull is under 26.5 mm long,** (*Pic 5*)
- Skull is very fragile. Rarely found complete in owl pellets
- Diastema is nearly twice as long as the row of cheek teeth, (*Pic 5*)



1. Lower jawbone



2. Root holes in lower jawbone



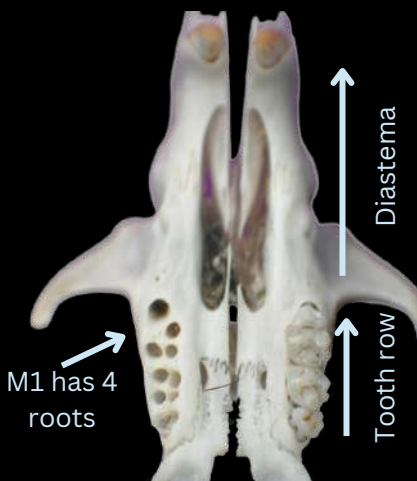
3. Cheek teeth in lower jawbone



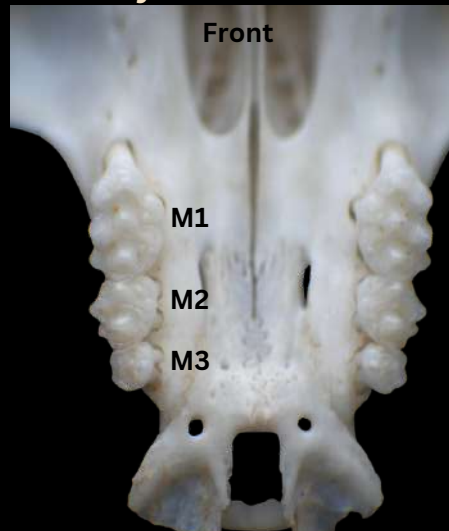
4. Un-notched incisor



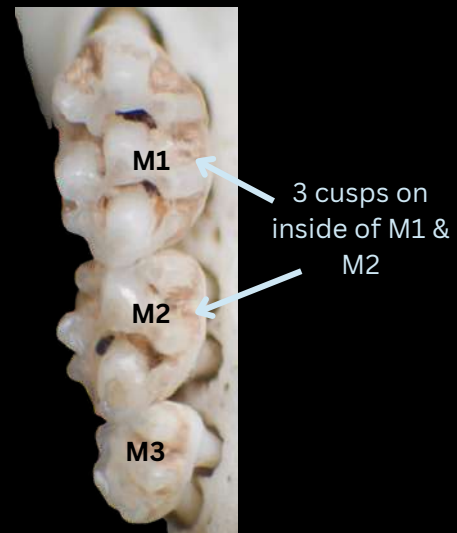
5. Cheek teeth and round root holes in underside of skull



6. Knobby cheek teeth



7. Cheek teeth in skull





Yellow-necked Mouse

Apodemus flavicollis

Unusual to find in barn owl pellets.

It is hard to differentiate between wood mouse and yellow-necked mouse. (2)

Skull, teeth and root holes are the same. Both belong to the *Apodemus* genus.

The yellow-necked mouse is larger. (2)



Teeth

- No notch on inside edge of the incisors, (5), (Pic 3)
- **Incisors are thicker than for the wood mouse.** Wood mouse's incisor, front to back is 1.1 - 1.3 mm thick. Yellow-necked mouse's incisor is 1.45 - 1.65mm thick, (4), (Pics 2 & 6)
- M1 and M2 in upper jaw have 3 cusps on the inner edge, (2)
- Front cheek tooth in lower jaw, M1, has 3 cusps at the front, (2), (Pic 5)
- Length of upper cheek teeth 4.0 - 4.4mm (4), (Pic 4)
- **Lower jaw longer than 16mm,** (5), (Pics 5 & 6)

Roots

- **Upper jaw, 11 root holes.** M1 has 4 roots, M2 has 4 roots, M3 has 3, so $4+4+3=11$, (2), (Pic 4)
- **Lower jaw, 6 root holes.** Roots of cheek teeth leave 6 round holes in jawbone, (2), (Pic 6)
- Lower jaw, M3 has 2 roots, (2), (Pic 6)

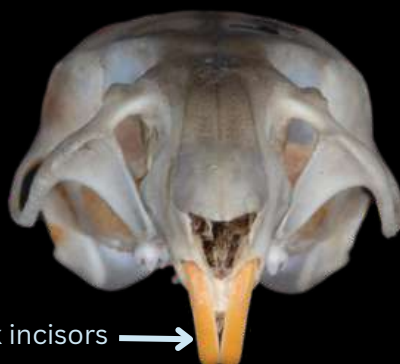
Skull

- **Skull is 26.5 - 29 mm long,** (9), (Pics 1,3 & 4)

1.Skull



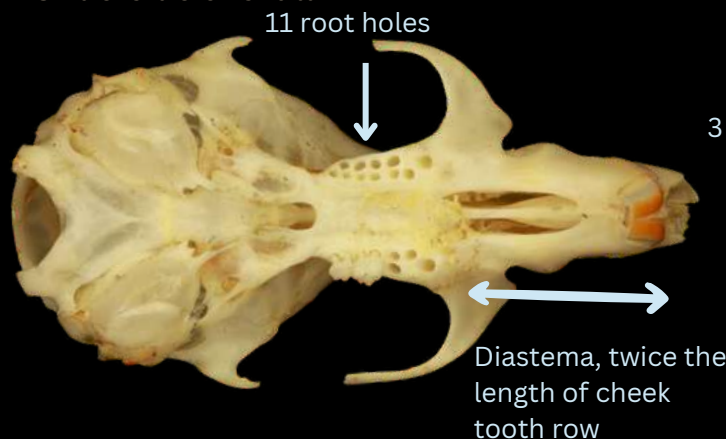
2.Skull*



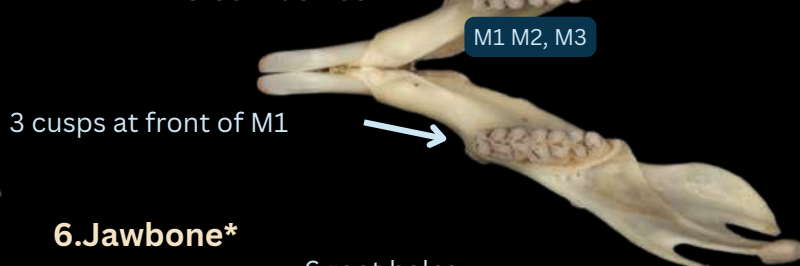
3.Skull*



4.Underside of skull*



5.Jawbones*



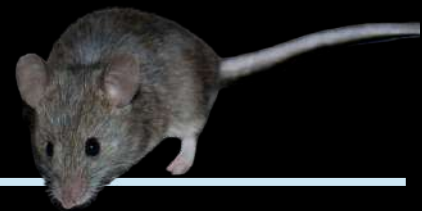
6.Jawbone*





House Mouse

Mus musculus



Notably smaller than wood mouse and so easily confused with harvest mouse, (5).
 Much less common in owl pellets than the wood mouse, (5).

Teeth

- **Upper incisor** is strongly curved and **has a notch at the tip, on the inside edge**, (2), (Pic 3)
- **M1 and M2 in upper jaw have 2 cusps on the inside edge**, (2), (Pic 6)
- **Front cheek tooth in lower jaw, M1, has 1 cusp at the front**, (2), (Pic 2)
- Length of upper cheek teeth 2.9 - 3.4mm, (4), (Pic 6)

Roots

- **Upper jaw, 8 root holes.** M1 has 3 roots, M2 has 3 roots, M3 has 2, so $3+3+2=8$, (2), (Pic 4)
- **Lower jaw, 5 root holes.** Roots of cheek teeth leave 5 holes in jawbone, (2)
- Lower jaw, M3 has 1 root, (5)

Skull

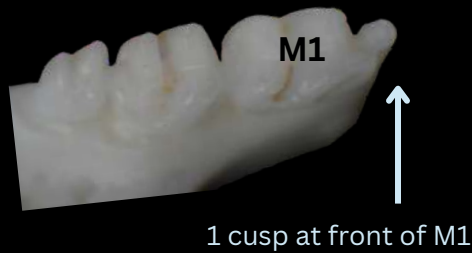
- Skull is 24mm long, (Pics 1 & 2)
- Skull and jawbone smaller than for the wood mouse (5)
- Lower jaw is shorter and deeper than for the wood mouse, (2)



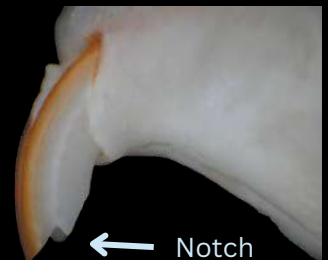
1.Skull



2.Cheek teeth in lower jawbone



3.Notched incisor



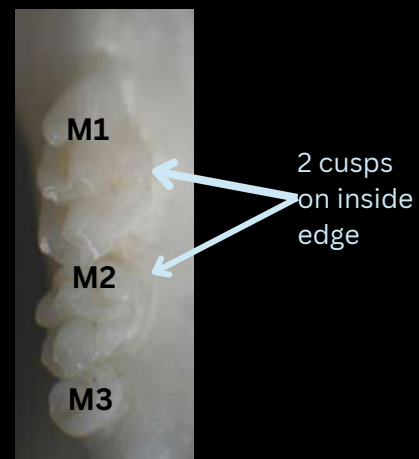
4.Underside of skull*



5.Jawbones



6.Cheek teeth in skull





Harvest Mouse

Micromys minutus



Rarely found in owl pellets but may be abundant in certain locations.

Very small.

Teeth

- No notch on the inside edge of the incisors
- Front cheek tooth in lower jaw, M1, has 3 cusps at the front, (*Pic 5*)
- Length of upper cheek teeth 2.6 - 2.8mm, (*Pic 4*)

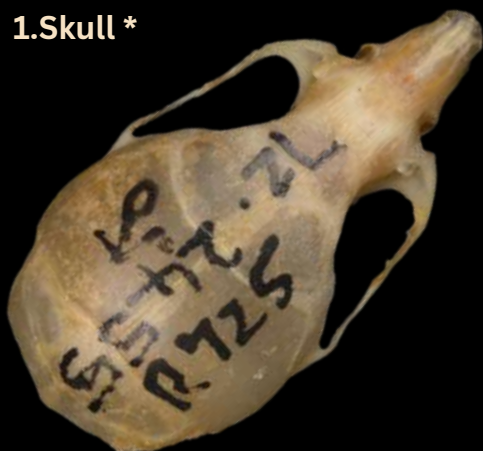
Roots

- **Upper jaw, 12 root holes.** M1, has 5 roots, M2 has 4 roots and M3 has 3, so $5+4+3 = 12$
- **Lower jaw, 7 root holes.** Cheek teeth leave 7 round holes in jawbone, (*Pic 2*)
- **Lower jaw, M1 has 3 roots, with the 2nd root hole much smaller** than the rest, (*Pic 2*)
- Lower jaw, M2 and M3 each have 2 roots, so $3+2+2=7$, (*Pic 2*)

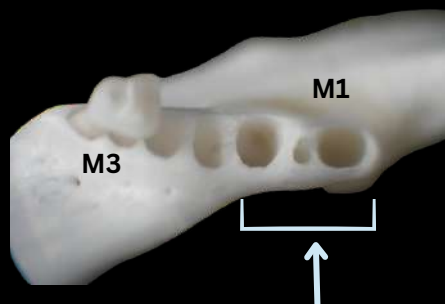
Skull

- **Skull is under 20 mm long**, (*Pics 1 & 4*)
- Skull is very fragile. Rarely found or extracted complete, in owl pellets (*Pics 1, 4 & 6*)

1. Skull *



2. Root holes in lower jawbone



3 root holes for M1. Second hole is very small.

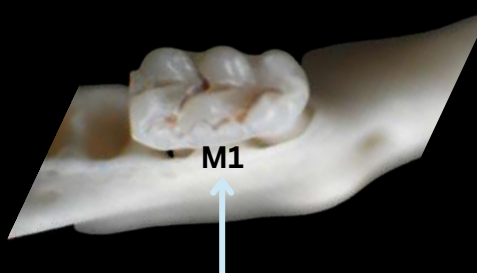
3. Lower incisor



4. Underside of skull *



5. M1 in Lower jawbone



3 cusps at front of M1

6. Skull *



No notch on inside of upper incisors



Brown Rat *Rattus Norvegicus*



Unusual prey of barn owls. The young are more likely to be caught. Clearly **much larger** than the mice.

Cheek tooth



Teeth

- No notch on incisors, which are much deeper than they are broad, (*Pics 1 & 4*)
- M1 and M2 in upper jaw have 2 cusps on the inside edge, (*Pic 6*)
- Front cheek tooth (M1) in lower jaw, has 1 cusp at the front, (*Pic 3*)
- Length of upper cheek teeth 6.4 - 8.0mm, (*Pic 5*)

Roots

- **Upper jaw, 12 root holes.** M1, has 5 roots. M2 has 4 roots and M3 has 3, so $5+4+3=12$, (*Pics 5 & 7*)
- **Lower jaw, 10 root holes.** Cheek teeth leave 10 holes in jawbone, (*Pic 2*)
- Lower jaw, M1 has 4 roots, M2 has 3, M3 has 3, so $4+3+3=10$, (*Pic 2*)

Skull

- **Skull is 43-54mm long**, (*Pic 1*)



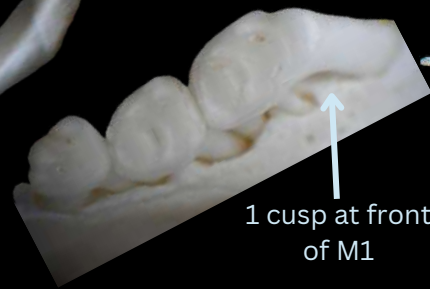
1. Skull



2. Ten root holes in lower jawbone



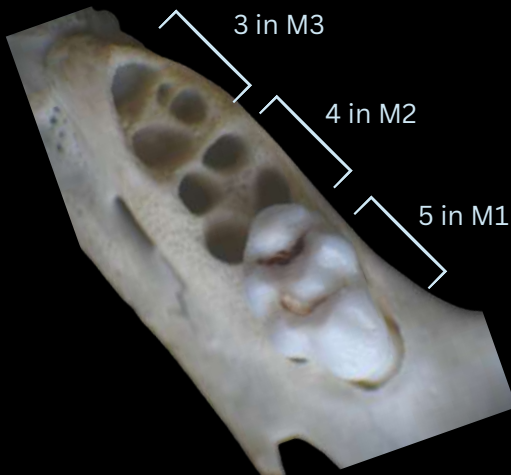
3. Cheek teeth in lower jawbone



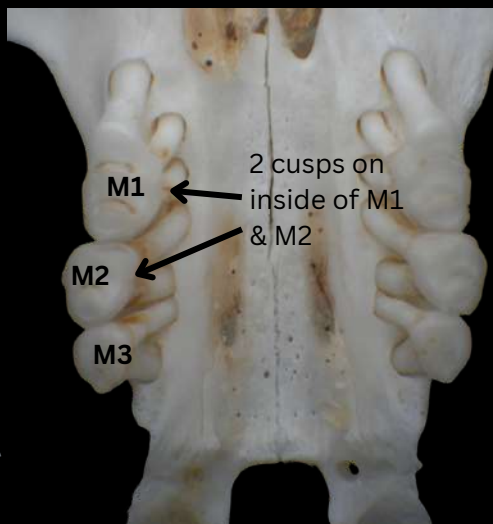
4. Un-notched incisors



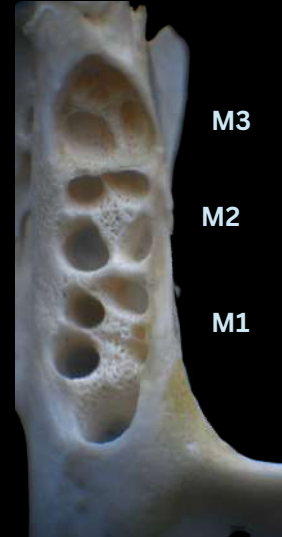
5. Twelve root holes in underside of skull



6. Cheek teeth in skull



7. Root holes in skull



8. Upper cheek teeth



Comparing Rodents' Jawbones & Root Holes

Jawbones

Wood Mouse



Field Vole



Brown Rat



Root Holes in Jawbones

Wood Mouse



Harvest Mouse



Brown Rat



Root Holes in Upper Jaw

Wood Mouse



Brown Rat



Field Vole

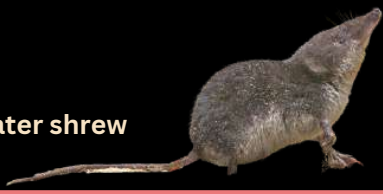


Bank Vole



Not To Scale!

Water shrew



Insectivores

Mole



Insectivores in the UK are small, ground-dwelling mammals which feed on invertebrates: insects like beetles, spiders, earthworms, slugs and snails.

They have a long narrow skull, a long snout and small eyes. They have a continuous row of small, pointed teeth. The incisors are conical and pointed. The cheek teeth have pointed cusps. Most shrew species have red-tipped teeth. There is no diastema, or gap, between the incisors and cheek teeth.

Insectivores found in owl pellets are mainly shrews; common, pygmy and water shrews and, in certain locations, the white-toothed species. Moles and small bats are rarely found in pellets. Hedgehogs are never present.

Mole skull



Front section of a Common shrew skull



Hedgehog skull



Not to scale!



Pygmy shrew

Shrews



Common shrew

Shrews are much smaller than voles and mice. They are insectivores, eating insects, caterpillars, earthworms and slugs. They have a continuous row of teeth with no gap behind the incisors. They grab their prey with their front incisors and eat it from the head down, biting off lumps. They chew with their large, jagged cheek teeth.

Most shrew species have red tips to the teeth. The red area contains an iron pigment, which strengthens that region of the teeth. Shrews are very small creatures, with relatively weak jaw muscles. The teeth need to be strong to catch and grip their prey and to break up the tough exoskeletons of insects, such as beetles.



Underside of water shrew skull

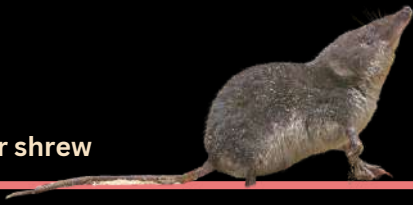
There are two species of shrews without the red tipped teeth: the greater and lesser white-toothed shrews. Other insectivores, such as bats and moles, also have no red tips on their teeth.

Shrews have elongate skulls which taper to a pointed snout. The lower incisor is almost horizontal. Behind the incisors, shrews have a row of small teeth each with a single point or cusp. These are the *unicuspids*. Behind these are jagged, pointed molars and premolars or cheek teeth.



Common shrew skull

Water shrew

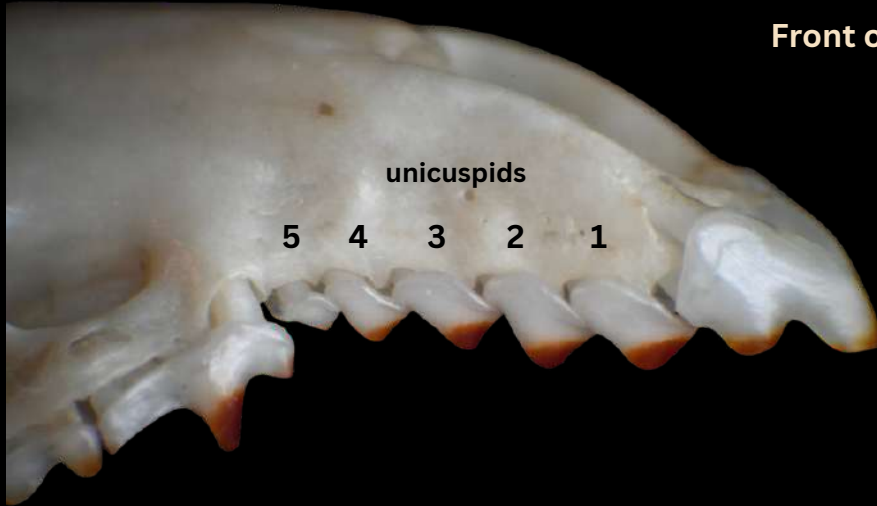


Shrews

Greater white-toothed shrew*



Common and pygmy shrews have 5 unicuspid in the upper jaw. Water shrews have 4 unicuspid. White-toothed shrews have 3.



Front of the skull of a common shrew

All shrews have 5 teeth in the lower jaw in addition to the long incisor. Often some of these lower teeth and/or the tiny unicuspid in the upper jaw will have fallen out or, for young shrews, may not have erupted yet. In that case, you can count the root holes. Generally root holes are not diagnostic for shrews, as they are for rodents.

The number of cusps on the lower incisor varies between the species.



Jawbone of a water shrew, showing six teeth in all.

Dental Formula

Common and pygmy shrew $3,1,3,3/1,1,1,3 = 32$

Water shrew $3,1,2,3/1,1,1,3 = 30$

White-toothed shrews $3,1,2,3/1,1,1,3 = 30$



Red-tipped molars/cheek teeth from a water shrew



Underside of a Pygmy Shrew Skull*

Incisors



5 unicuspid



Cheek teeth



Ear cavity



Lesser White-toothed Shrew *



Not to scale!

Water Shrew, Jawbone

Incisor



Cusp on incisor



5 Cheek teeth

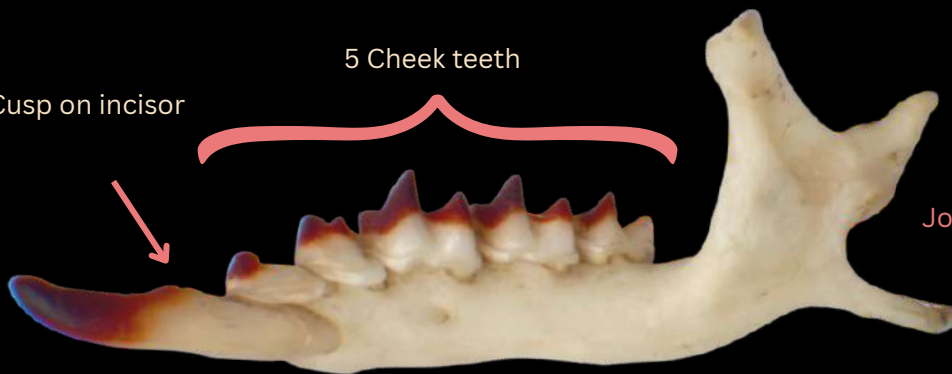


Joint surfaces



Front

Back





Common Shrew

Sorex araneus



Common prey of all owls. Also known as the Eurasian shrew.

The red-toothed shrew on Jersey, the Millet shrew, is a different species but has exactly the same features as the Common shrew. The Jersey shrew is also known as the French shrew.

Teeth & Jawbone

- **Lower incisor: first two cusps are clumped together**, then 2 smaller cusps, (*Pic 5*)
- 5 unicuspid in upper jaw, (*Pics 2 & 3*)
- **3rd upper unicuspid is smaller than 2nd**. Unicuspids 3-5 are very small, (*Pics 2 & 3*)
- Length of upper tooth row is 8.0 -8.8mm, (*Pic 2*)
- **Jawbone, inside, has a tall, pyramid-shaped cavity on the vertical section**, (*Pic 6*)

Skull

- **Skull is 19-20mm long**, (*Pic 1*)
- Long skull, tapers towards the snout, (*Pics 1 & 4*)
- Skull is very fragile. Rarely found complete in an owl pellet



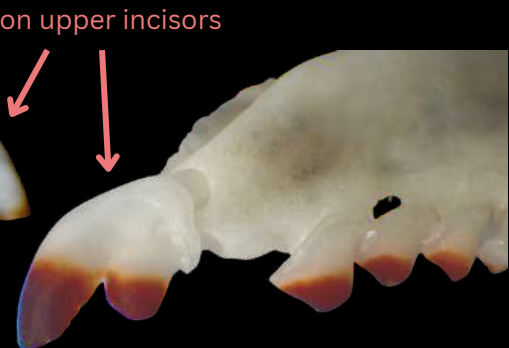
1. Skull



2. Incisor, unicuspids & molars in upper jaw



3. Front of upper jaw



4. Underside of front section of skull



5. Jawbone, outside



6. Jawbone, inside





Pygmy Shrew *Sorex minutus*

Common prey of all owls.

Much smaller than the voles and mice and smaller than the common shrew. Easily missed!

Teeth & Jawbone

- **Lower incisor has 4 cusps, evenly spaced,** (Pic 5)
- 5 unicuspid in the upper jaw, (Pic 2)
- **3rd upper unicuspid is bigger than 2nd,** (Pic 2)
- Length of upper tooth row is 6.2 - 6.6 mm, (Pics 2 & 4)
- Jawbone, inside, has a dome-shaped cavity on the vertical section, (Pic 6)



Dead common shrew & pygmy shrew, showing relative size and relative length of tails

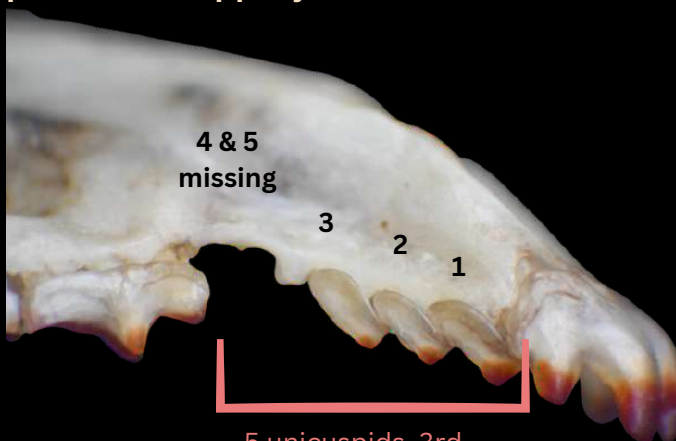
Skull

- **Skull is 15-16mm long,** (Pic 1)
- Long skull, tapers towards the snout, (Pic 1)
- Skull is very fragile. Rarely found complete in an owl pellet

1. Skull *



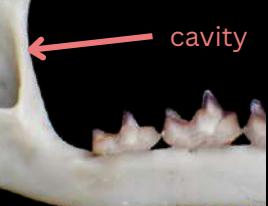
2. Incisor, unicuspid & premolar in upper jaw



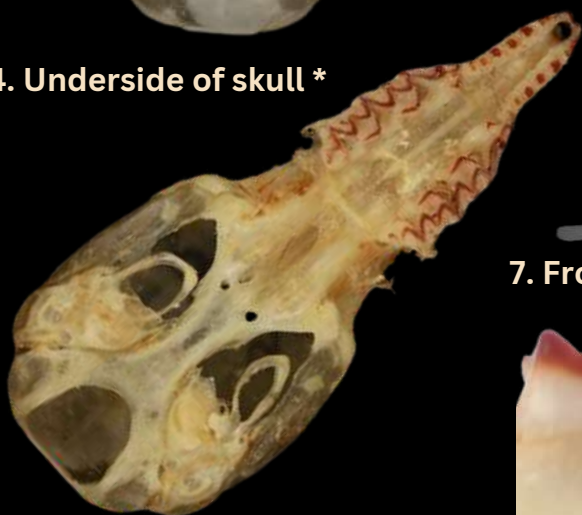
3. Incisors at front of upper jaw



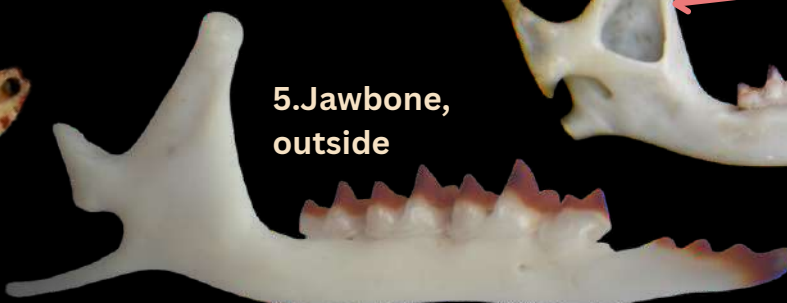
6. Jawbone, inside



4. Underside of skull *



5. Jawbone, outside



7. Front Section of Jawbone





Water Shrew *Neomys fodiens*

Rare to find in owl pellets.
Largest of the shrews.

Lower incisor, showing root and 2 cusps



Teeth & Jawbone

Lower incisor is a long, smooth blade with 1 cusp midway along, (*Inset & Pics 4 & 5*)

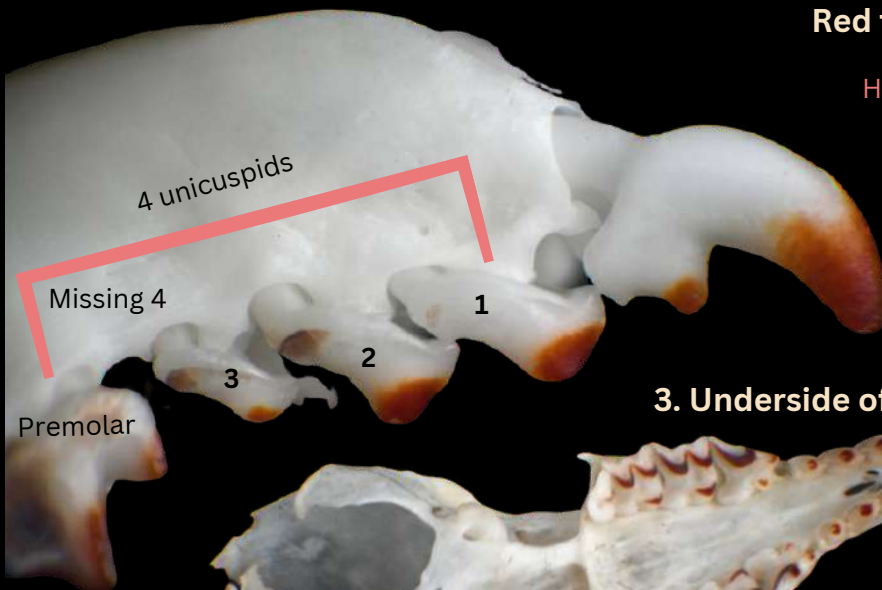
- **Upper incisor is hooked,** 2nd cusp much smaller than 1st, (*Pics 1 & 2*)
- **4 unicuspid in the upper jaw,** (*Pics 1, 2 & 3*)
- **3rd & 4th unicuspid in upper jaw are smaller than 1st & 2nd,** (*Pic 1*)
- Length of upper tooth row is 9.6 - 10.2mm
- **Jawbone, inside, has short, dome-shaped cavity on the vertical section,** (*Pic 4*)

Skull

- **Skull is over 20mm long,** (*Pic 3*)
- Fragile, long skull, tapers towards the snout, (*Pic 3*)



1. Incisor and unicuspid in upper jaw



2. Teeth at front of upper jaw.
Red tips have worn away. An old shrew!

Hook-like Incisor



3. Underside of skull

3 unicuspid and 1 hole



4 Jawbone, inside

short, dome-shaped cavity



5. Jawbone, outside

5 teeth plus incisor

Long, smooth blade-like incisor





Lesser White-toothed Shrew

Crocidura suaveolens



Only occurs naturally on the Scilly isles, Jersey & Sark.
Sometimes known as the Scilly shrew.

Teeth

- **No red tips to the teeth**, (Pics 2, 3 & 4)
- Lower incisor is a long, smooth blade with one cusp midway along, like *Neomys*, (Pic 4)
- Upper incisor is hooked, 2nd cusp much smaller than the 1st, like *Neomys*
- 3 unicuspid in the upper jaw, (Pic 2 & 3)
- **2nd upper unicuspid is shorter than 3rd, in side profile**, (Pic 2)
- **Length of upper tooth row from incisor to M3 is 6.8mm to M3 is 6.8mm**, (Pics 2 & 3)
- **Length of lower tooth row from incisor to M3 is 4.9mm**, (Pic 4)

Skull

- **Average skull length is 16.6mm**, (Pics 1, 2 & 3)
- Long skull, tapers towards the snout, (Pics 1, 2 & 3)

1. Skull *



2. Skull *

White teeth!



3. Underside of skull *



4. Jawbone, inside

Long, blade-like lower incisor, with a slight cusp, midway





Greater White-toothed Shrew

Crocidura russula

Occurs naturally in Guernsey, Alderney & Herm. Recently discovered in North-east England.

A newly-discovered invasive mammal species for England, confirmed in 2022.

Important to discover in owl pellets, so that it's geographical spread and impact on other native, small mammal species can be measured and monitored.

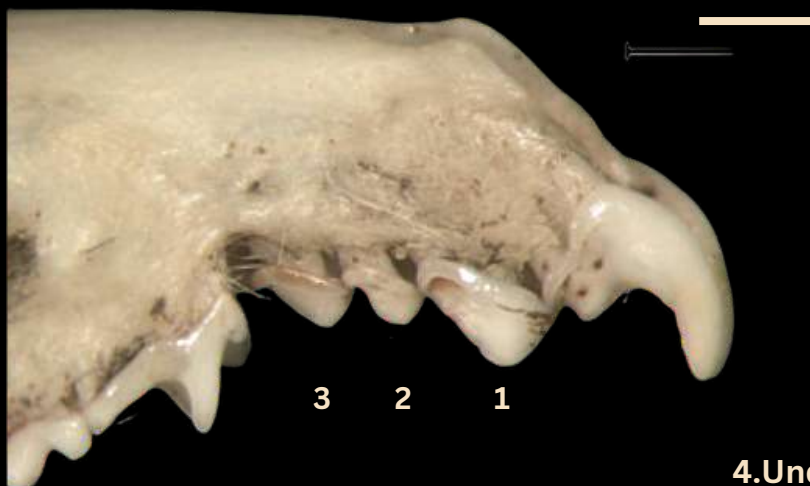
Teeth

- **No red tips to the teeth**
- Lower incisor is a long, smooth blade with a slight cusp midway along, like *Neomys*, (Pic 2)
- Upper incisor is hooked, 2nd cusp much smaller than the 1st, like *Neomys*, (Pics 1 & 2)
- 3 unicuspid in the upper jaw, (Pics 1 & 4)
- **3rd upper unicuspid is equal height to the 2nd, in side profile**, (Pic 1)
- **Length of upper tooth row from incisor to M3 is 8.4mm**, (Pic 1)
- **Length of lower tooth row from incisor to M3 is 5.8mm**, (Pic 2)

Skull

- **Average skull length is 19.1mm**, (Pic 3)
- Long skull, tapers towards the snout, which is thicker than for other shrew species, (Pic 3)

1. First incisor, unicuspid and premolars



2. Jawbone, outside



3. Skull

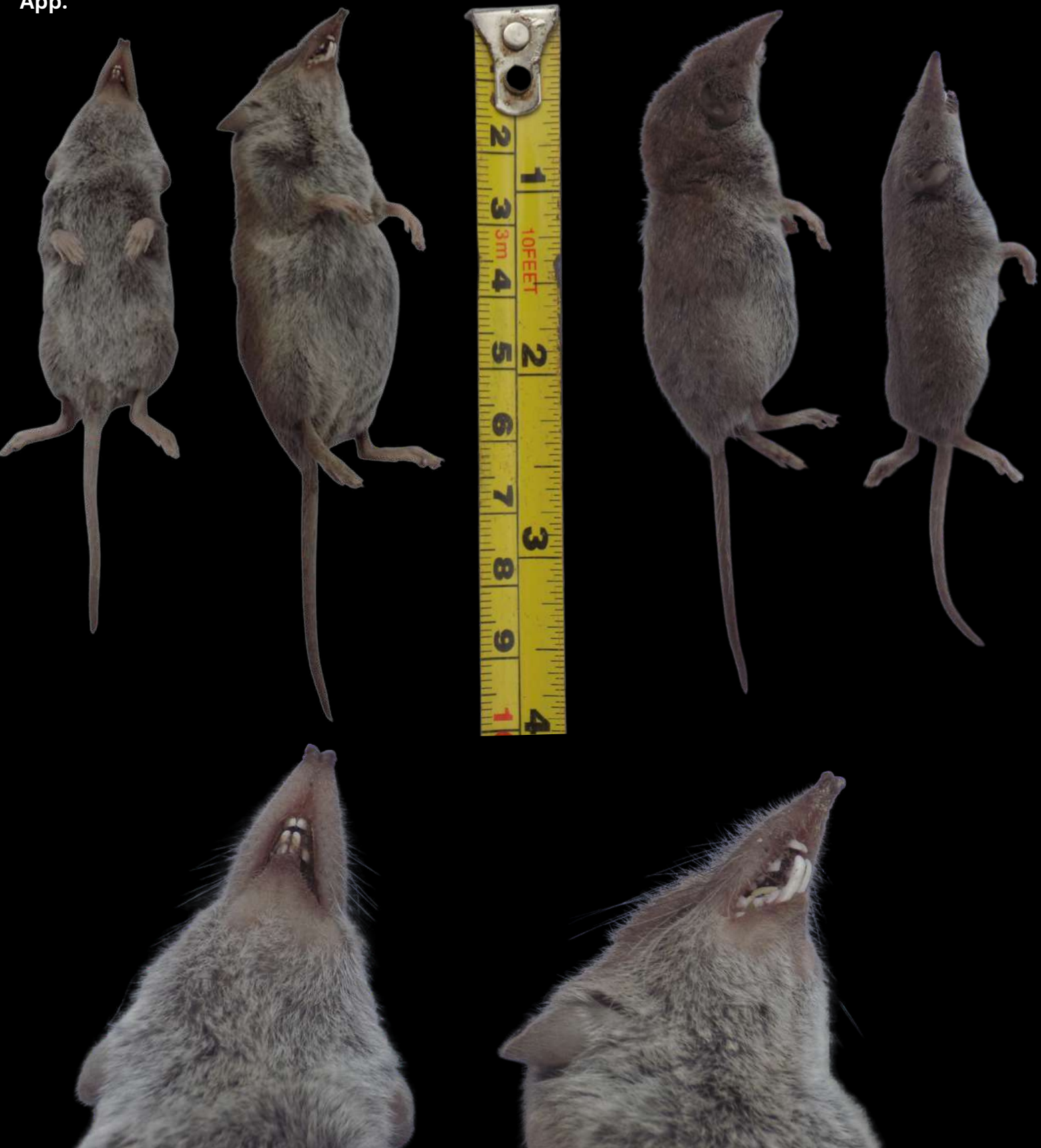


4. Underside of skull



Photos of the Greater White-toothed Shrew *Crocidura russula*

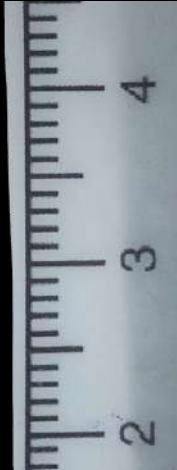
This is a **newly-discovered invasive mammal species** for England, in 2022. If you spot one or find its remains in an owl pellet, please report it to the Mammal Society using the Mammal Mapper App.



Comparing Shrews' Skulls & Jawbones

Skulls

Pygmy shrew (*Sorex minutus*)



Greater white-toothed shrew (*Crocidura russula*)



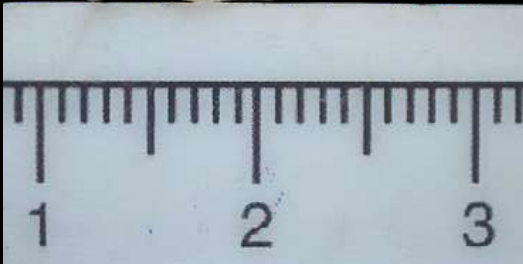
Jawbones



Pygmy shrew (*Sorex minutus*)



Greater white-toothed shrew (*Crocidura russula*)



Lesser white-toothed shrew (*Crocidura suaveolens*)



Water shrew (*Neomys fodiens*)



Greater white-toothed shrew (*Crocidura russula*)



Common shrew (*Sorex araneus*)



Pygmy shrew (*Sorex minutus*)



15mm

Comparing Shrews' Lower Incisors

Not to Scale!



Water shrew (*Neomys fodiens*)



Greater white-toothed shrew (*Crocidura russula*)



Common shrew (*Sorex araneus*)



Lesser white-toothed shrew * (*Crocidura suaveolens*)



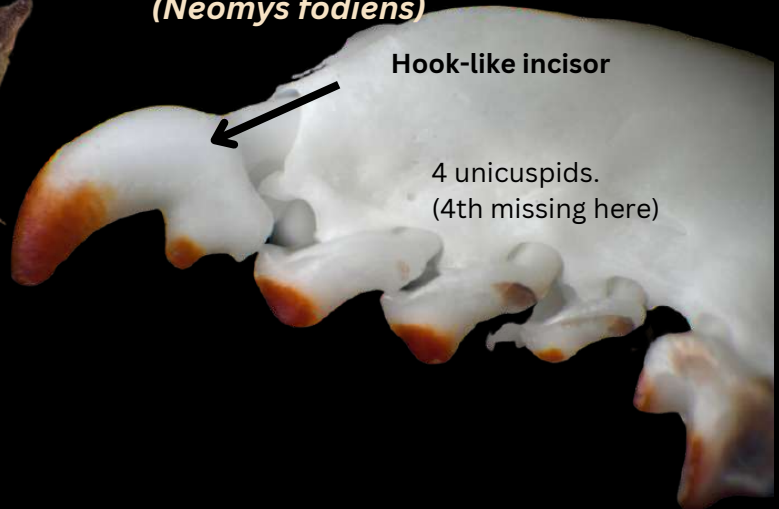
Pygmy shrew (*Sorex minutus*)

Comparing Shrews' Upper Incisors & Unicuspids

Not to Scale!



Water shrew
(*Neomys fodiens*)



Hook-like incisor

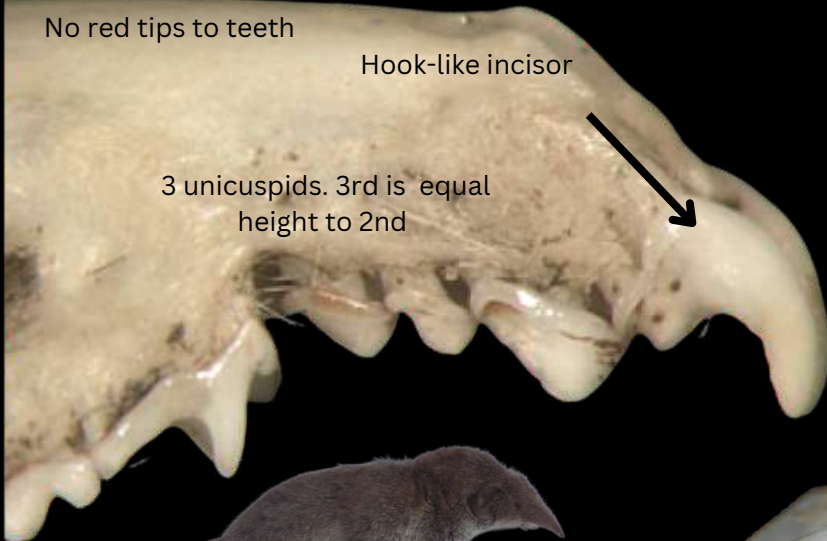
4 unicuspids.
(4th missing here)

Greater white-toothed shrew
(*Crocidura russula*)

No red tips to teeth

Hook-like incisor

3 unicuspids. 3rd is equal
height to 2nd



Common shrew
(*Sorex araneus*)



Lesser white-toothed shrew*
(*Crocidura suaveolens*)

No red tips to teeth

Hook-like incisor

3 unicuspids




Pygmy shrew
(*Sorex minutus*)

5 unicuspids. (4 + 5 are missing here)
3rd is larger than 2nd



Other Small Mammal Bones in Barn Owl Pellets

<p>Mouse Incisor</p> 	<p>Vole Incisor</p> 	<p>Vole Molars</p> 
<p>Vertebrae</p> 	<p>Ribs</p> 	<p>Shoulder Blade</p> 
<p>Humerus</p> 	<p>Forearm</p> 	<p>Rodent Hip Bone</p> 
<p>Thigh</p> 	<p>Shin</p> 	<p>Tail Vertebrae</p> 
<p>Shrew Hip Bone</p> 	<p>Part of Spine</p> 	<p>Ear Cavity</p> 

Not to scale. These bones are tiny!



Hazel dormouse

Other Mammals

Moles, Bats & Hazel Dormice



Mole

Sometimes other small mammals, especially juveniles, may be found in barn owl pellets. These include:

Mole

Talpa europaea



Mole jaws

Skull (40mm), looks like a large shrew with no red tips to the teeth. Lower 1st incisor is not horizontal. Upper canine has 2 roots. Lower canines look the same as the incisors.



Claws in a barn owl pellet!



May be identified by large claws, very long (2.5cm), narrow scapula or unusually-shaped, broad humerus.



Front claw, scapula and humerus

Bats

Skull is shorter than for shrews. White teeth. Prominent canines. May be identified by long, thin, curved wing bones which look like fish bones. Size varies with species but usually only very small bats may be preyed on by owls.



Skull & wing bones



Hazel Dormouse

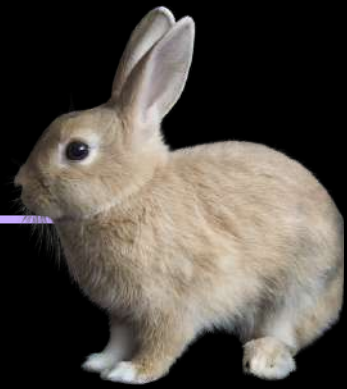
Muscardinus avellanarius



Dormice have 4 cheek teeth on each side, each with several ridges, at right angles to the jawbone, across the grinding surface.



Other Mammals Rabbit & Weasel



Rabbit

Oryctolagus cuniculus

Young rabbits may be eaten by barn owls. Juveniles may have just one cheek tooth on each side. The cheek teeth have a crown of 2 oval cusps. The cheek teeth and upper incisors have a deep groove down the full length.



Ridges running down the incisors

Jawbone



Underside of skull



Weasel

Mustela nivalis

Again rare in pellets. Skull is large and sturdy with large canines and sharp-cusped, cheek teeth.



Weasel Skull *
Note the prominent canines!



Birds



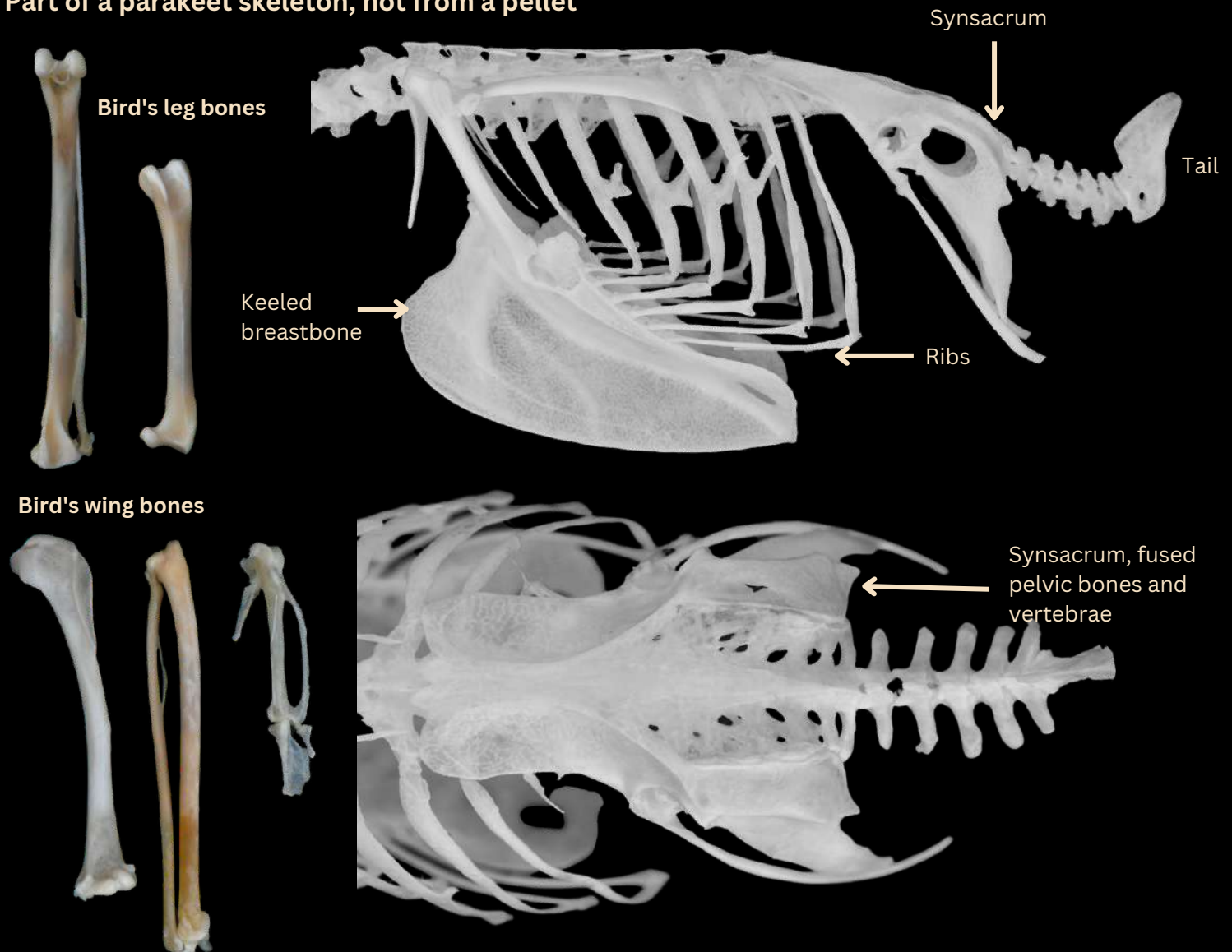
Barn owls sometimes eat smaller birds like starlings, thrushes, blackbirds, sparrows, finches and pipits. The surrounding material in the pellet, the *matrix*, may contain feathers rather than, or as well as, fur. Bird bones are very light and fragile.

In the pellets, you may find a beak, skull, breastbone, (*sternum*) or distinctively-shaped pelvic bones, (*synsacrum*).

House sparrow, goldfinch & robin skulls



Part of a parakeet skeleton, not from a pellet





Frogs, Toads & Fish



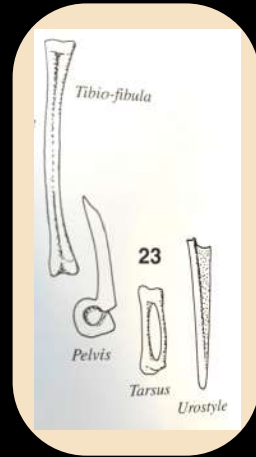
Sometimes the remains of other animals are in barn owl pellets. These include:

Frogs & Toads

The long bones are double-barrelled. Look for the distinctive T-shaped bone which is part of the skull and the pelvis shaped like a 'd'. You could find separate frog/toad bones in the pellets, not the complete skeleton!*



Frog skull & skeleton



Frog bones

Fish

Fish bones are transparent. Vertebrae are like a cotton reel, concave at both ends. Scales may be present too and thin, needle-like bones.

Vertebrae



Scales





Invertebrates

Beetles

Parts of the shiny black or purple exoskeletons from ground beetles and dung beetles, amongst others, are often found in pellets from tawny and little owl but rarely in barn owl pellets. The wing cases, *elytra*, are grooved or pitted half-ovals. The lower leg segments have a notched edge and the femur is a long oval.



Caterpillars & Grasshoppers

If these have been eaten, instead of fur, the pellet matrix consists of vegetable fragments. You may find the tiny, shiny, brown jaws made of chitin from caterpillars (A) and grasshoppers (B).

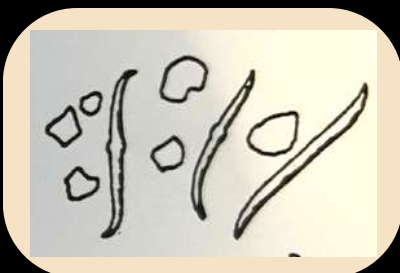


*



Earthworms

If the owl had been eating earthworms, the matrix will be very gritty. Under a microscope you may see their shiny, golden bristles, *chaetae*.



*





Wood mouse

Glossary



Bank vole

Types of Teeth

Incisors: Front teeth. Flat, sharp-edged, used to bite, nibble, gnaw, cut and strip.

Canines: Behind the incisors. Pointed, cone-shaped. Large in carnivores. May be absent in herbivores. Used to seize prey, pierce flesh and tear.

Premolars: Between the canines & molars. Broad-based, with ridges or cusps on the surface. Used to grind, crush and sometimes, slice food.

Molars: Furthest back in the mouth. May have several cusps. Used to grind and crush.

Unicuspid: Teeth which have just one small point or cusp. For shrews, between 1st incisor and cheek teeth.

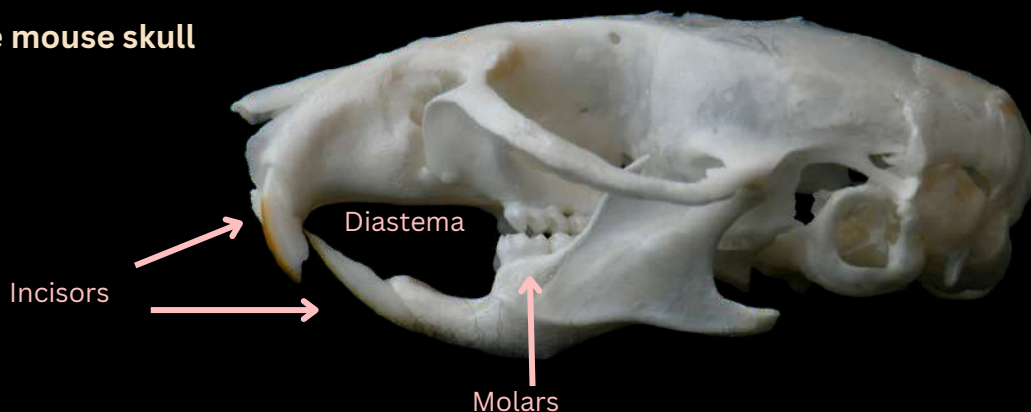
Diastema

The gap in the mouth between the incisors and molars. The diastema is present in herbivores such as *lagomorphs* (rabbits & hares) and *artiodactyls* (deer) and in rodents, which are omnivores. The mammals can suck the inside of their cheeks into this space, to prevent food passing down the throat while it is being gathered and processed by the incisors and tongue.

Dental Formula

The number of teeth of each type, which a particular mammal species has, can be described with a formula. The first set of numbers refers to the upper teeth and the second set to the lower teeth. The numbers describe the teeth on one side of the jaw. (The tooth pattern is always symmetrical, from one side to the other.)

House mouse skull



For example, rodents have 1 incisor and 3 molars in the upper and lower jaw, no canines or premolars, so their dental formula is (1,0,0,3/1,0,0,3).



Barn Owl Skull



Skull Photos *



Water vole

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Field vole

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Co-operation with The Natural History Museum, London

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