



Manaaki Whenua  
Landcare Research

# CHEWCARDS

## A guide to the interpretation of animal tooth impressions

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## Using this guide

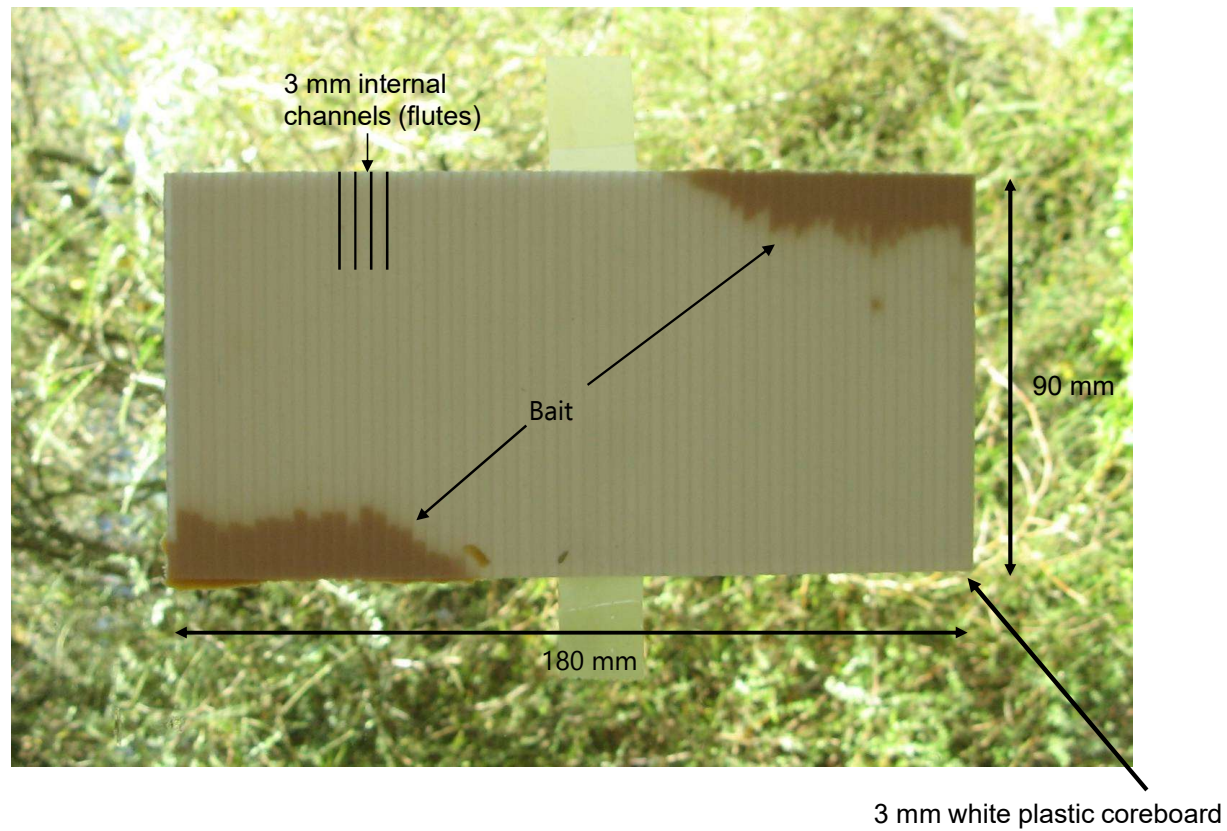


This guide describes chewcards and how to use them, and provides detailed photographs and descriptions of the marks made by animals that bite them.

It starts with, and provides the most detail for, the most common species that interact with chewcards in New Zealand (possums then rodents), but also covers most animals likely to bite chewcards.

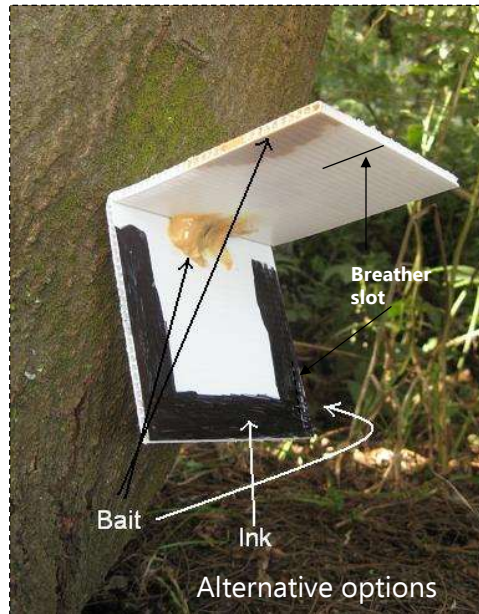
Users can scroll down through each slide from the start, or use the bookmark tab on the left of the screen to quickly navigate to sections of interest.

## Chewcard design



Bait is usually pressed into two opposite corners of the card, penetrating about 2 cm into the flutes (internal channels.)

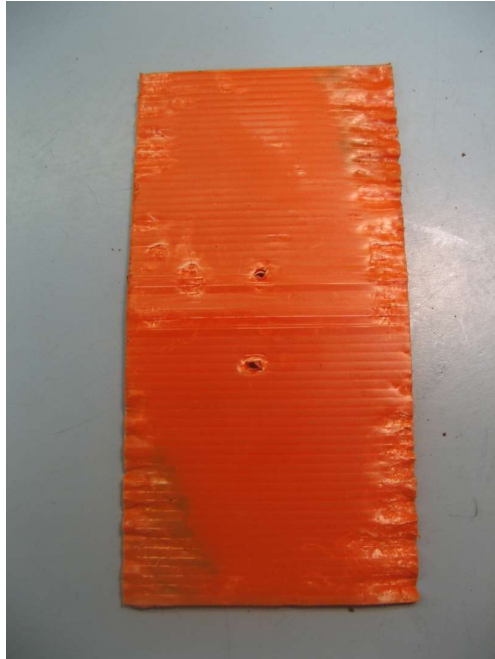
## Chewcard sets



Use 50 mm fibreboard nails (clouts) to mount card in a right-angled position with top of card horizontal. Insert nail about 10 mm from fold on top side and 5 mm from fold on bottom side to help maintain the required angle. The clout will be hammered at an angle of about 45° to the tree trunk about 30 cm off the ground. Addition of ink can be useful for tracking mice and invertebrates, and the breather slot allows baits to be inserted at all four corners of the card if required.

**Possum:**

Classic bite marks; marginal crushing



Classic possum sign is extensively crushed margins with or without isolated bite marks. Biting and crushing can extend well beyond the baited portions of the card. However, other species can crush chewcard margins as well, therefore, it will usually be necessary to positively identify discrete tooth impressions to confirm possum identification. (See slides 7-19.)

**Possum:**  
crushed card margins



Close-up of possum-crushed margins. Note that bite marks are generally indistinct within the crushed zone.

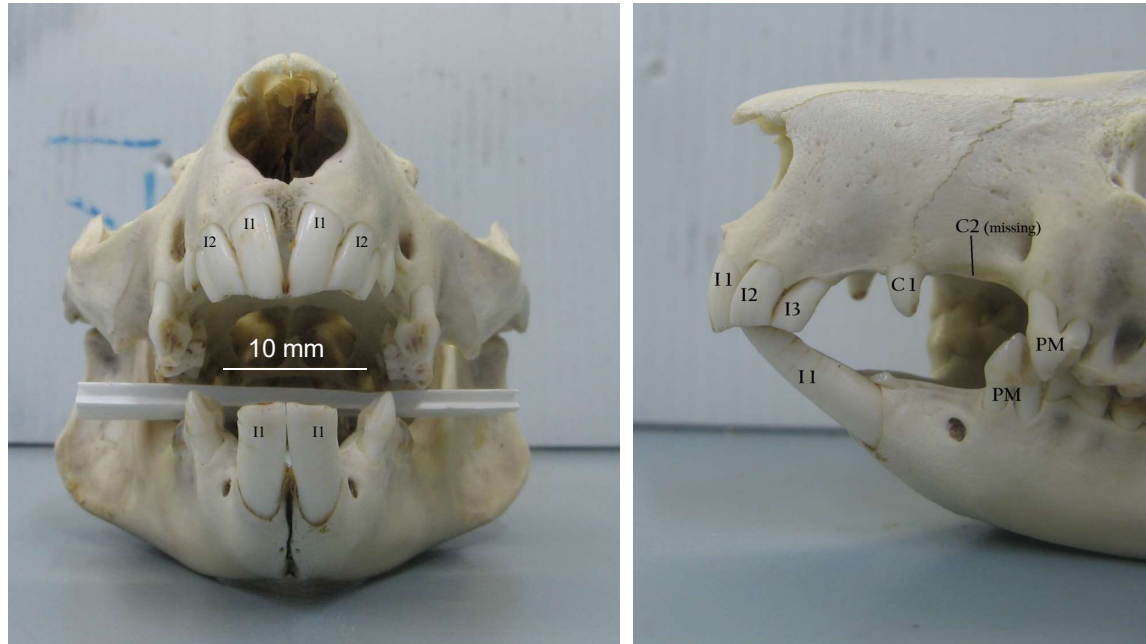
**Possum:**

narrow crushed margins



Crushing by possums is sometimes confined to a very narrow strip along baited margins. In such cases there may be no tooth impressions on the lower card surface.

## Possum teeth



Possum skull with teeth identified: I = incisor, C = canines, PM = premolar. Molars are located behind the premolar.



## Possum teeth:



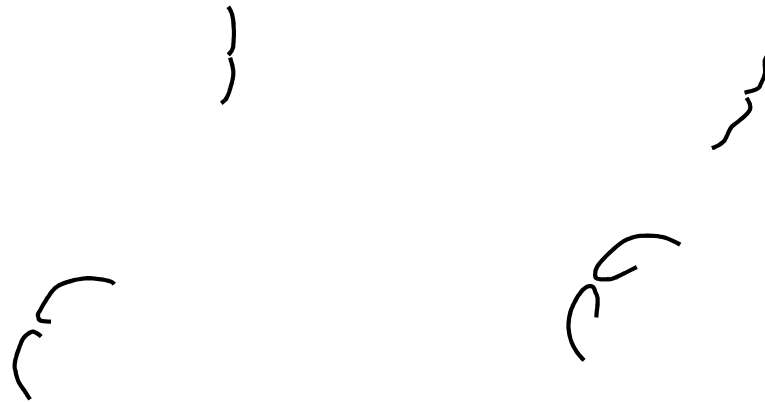
Details of the incisors. Most tooth impressions made by possums are from the I1 incisors (upper and lower jaws).

## Possum teeth: impression profiles



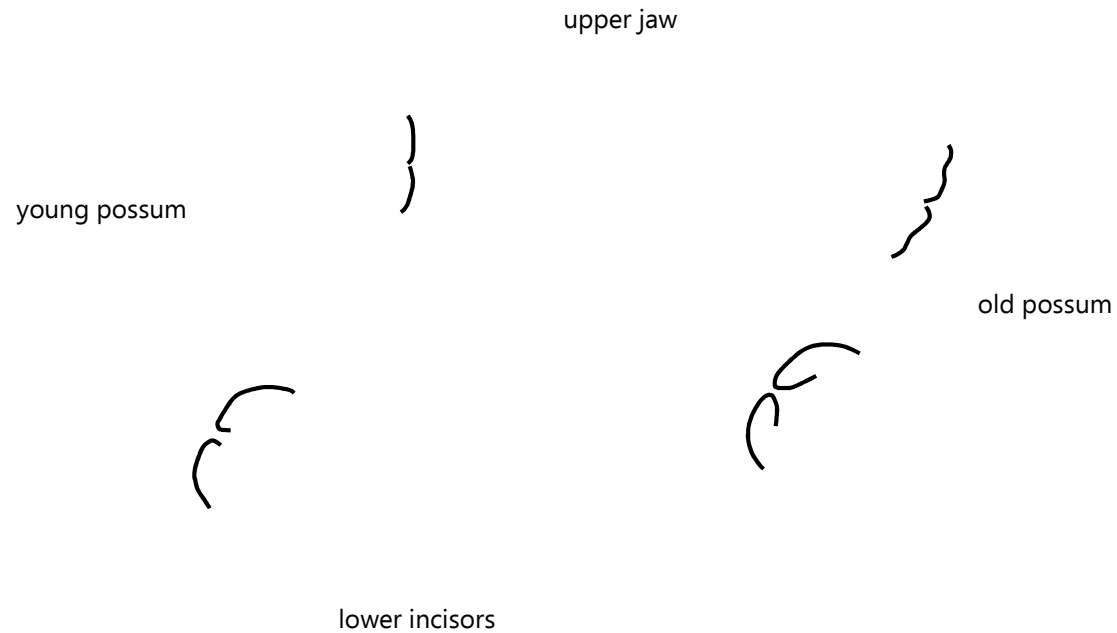
Details of the incisors. Note that the tooth contact profiles have been highlighted. The skull on the right is from an old animal with the I1 teeth exhibiting the wavy profile frequently seen on older worn teeth.

## Possum teeth: impression profiles



These shapes are the typical impression profiles made by possum incisors. Try and locate these types of impressions in and around the crushed areas, and along all margins and the fold line.

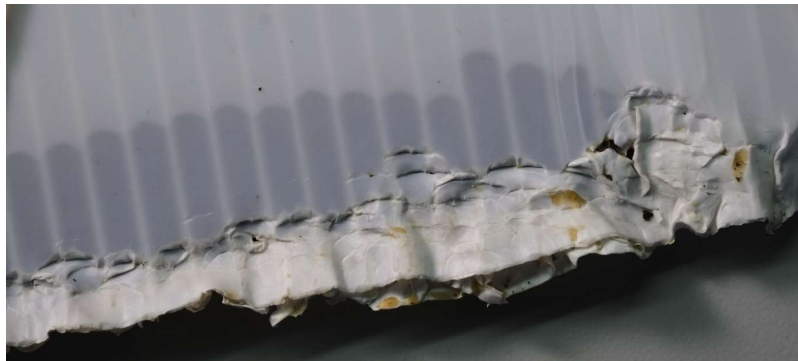
## Possum teeth: impression profiles



These shapes are the typical impression profiles made by possum incisors. Try and locate these types of impressions in and around the crushed areas, and along all margins and the fold line.

**Possum:**

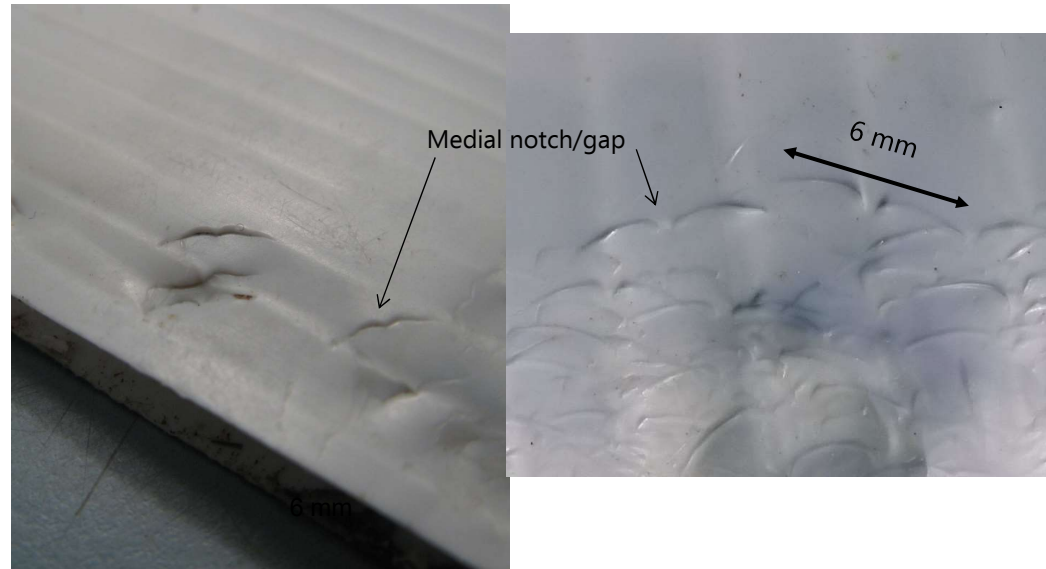
crushed margins with incisor impressions



Clear possum incisor-pair impressions (lower and upper pairs) are diagnostic, with and without card crushing. Impression pairs in and around crushed margins vary from indistinct (top) to very distinctive (bottom). Fully formed incisor-pairs are 4.5 to 7 mm wide.



**Possum:**  
upper incisor-pair impressions

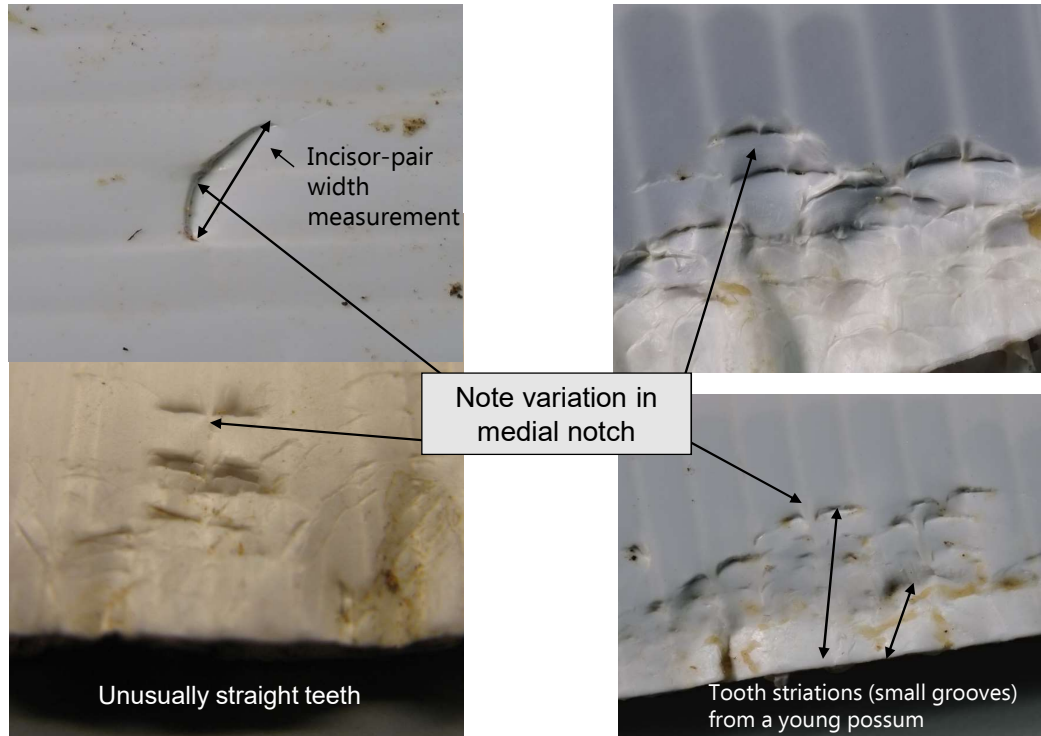


**Key features:** In pairs totalling 4–7mm across, separated by medial notch; teeth usually curved (variable shape)

Incisor-pair impressions always have a 'medial mark' between the I1 teeth in possums. This varies from a minor notch to a gap up to 1 mm wide.



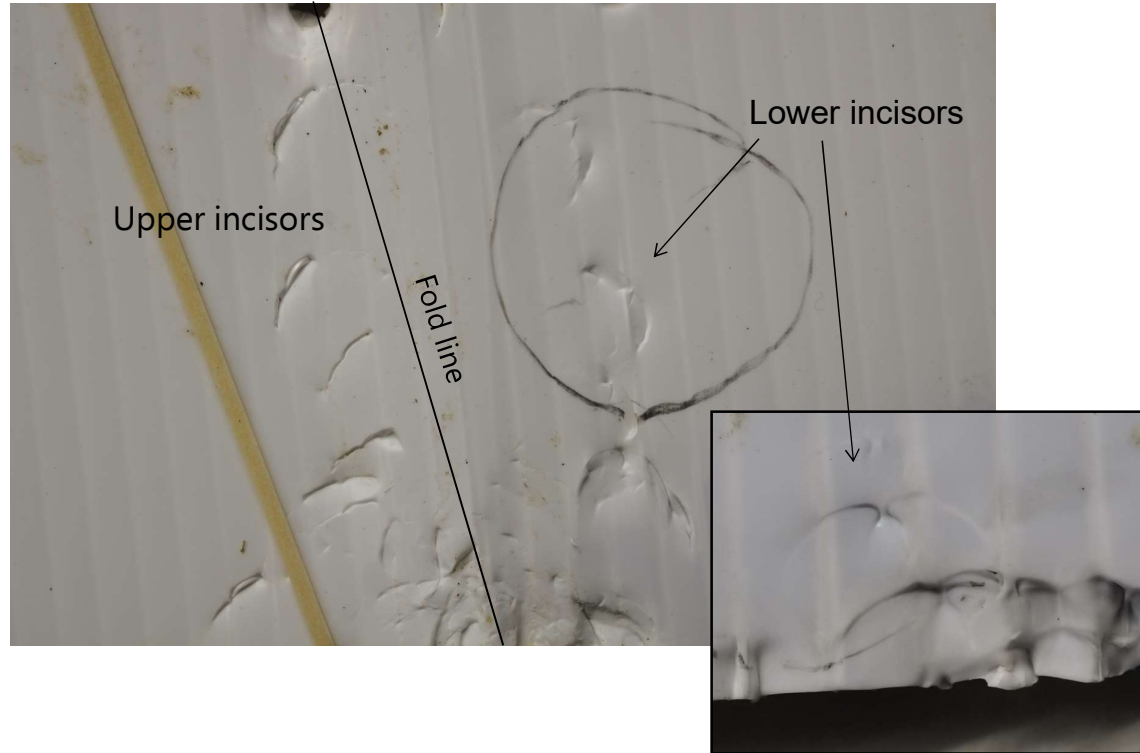
**Possum:**  
upper incisor impressions



There is quite a range in incisor-pair shapes, but all conform to the width (4.5 to 7 mm) and medial notch/gap requirements for possum diagnostics.



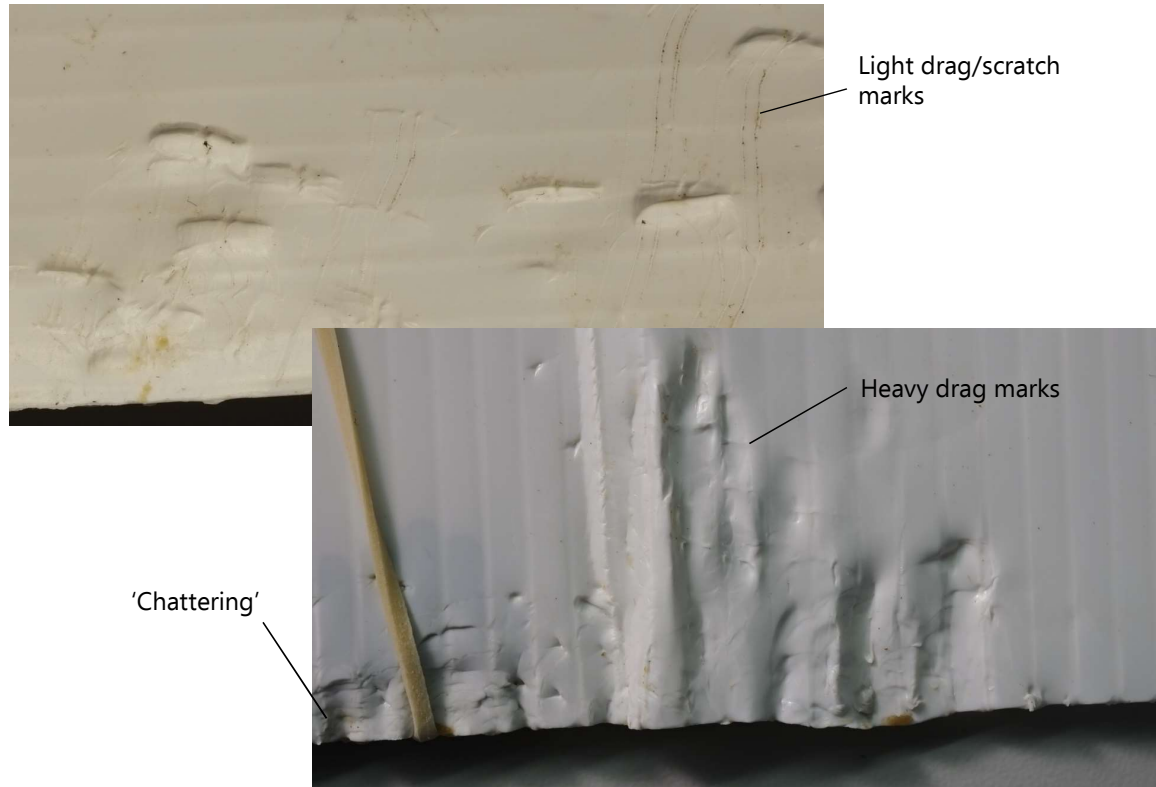
**Possum:**  
upper and lower incisors



Lower incisor-pair impressions are more curved than upper impressions, and frequently reveal the tooth thickness c/o a simple impression line.



**Possum:**  
incisor drag marks



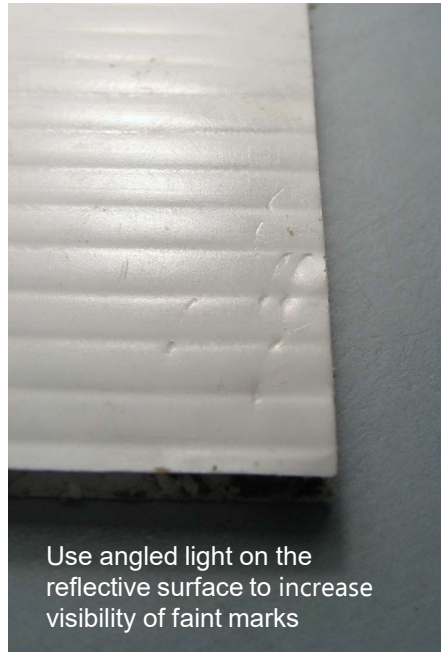
Possum incisor impressions are frequently dragged, producing scrape marks or long depressions ± numerous 'chatter' lines where the possum has repeatedly bitten down while pulling/dragging its incisors across the card surface.

**Possum:**  
light biting

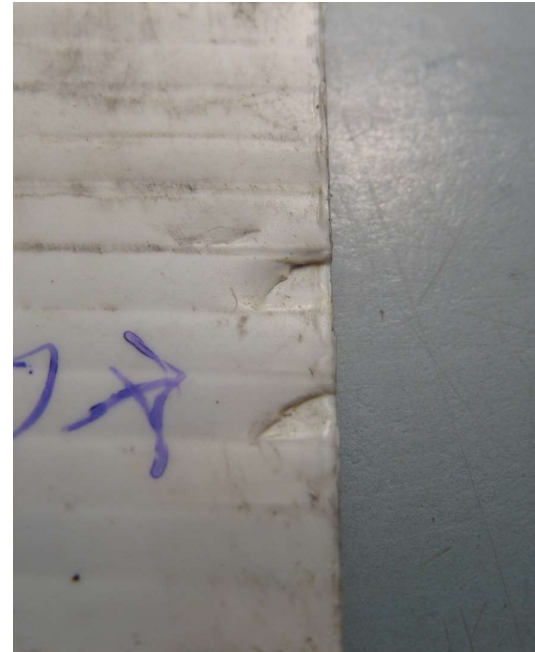


Some possums will leave only very light bite marks, requiring careful inspection of all cards that initially appear untouched.

**Possum:**  
light biting



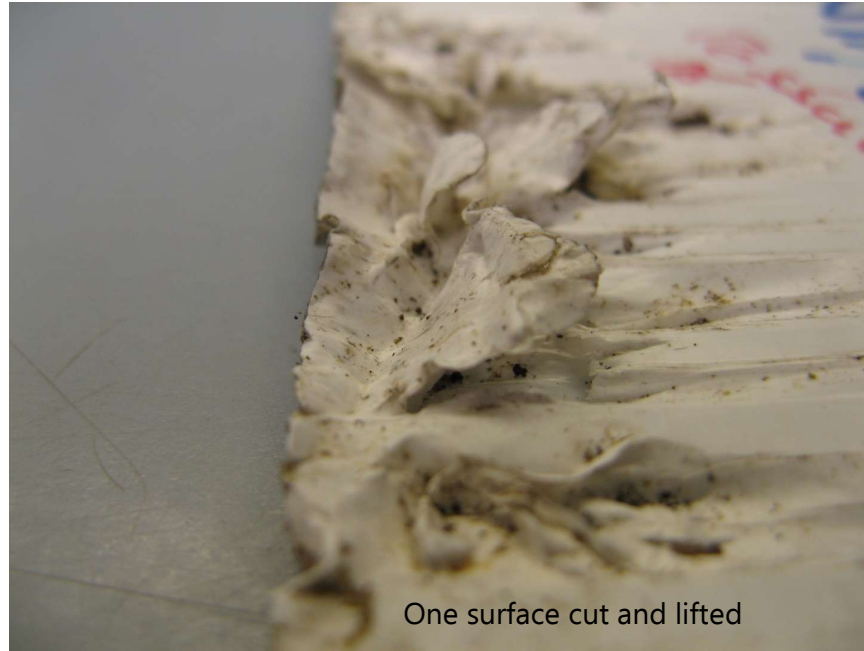
Use angled light on the reflective surface to increase visibility of faint marks



Check all margins and the centre fold line

Using an angled bright light will help highlight indistinct marks against the shiny card surface.

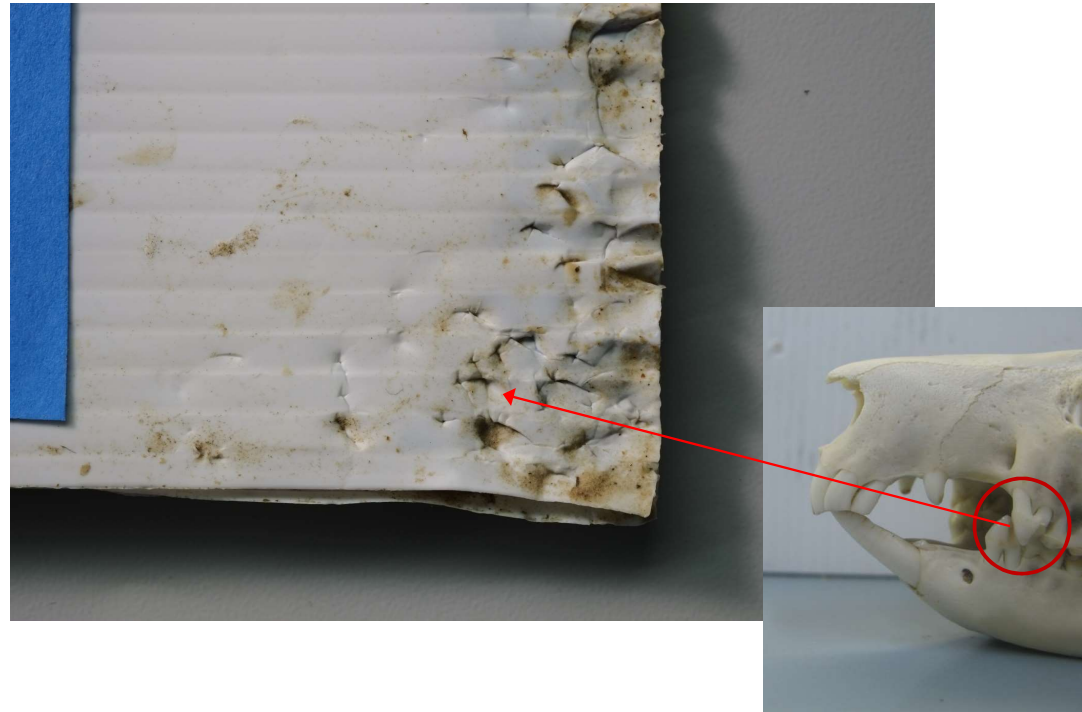
**Possum:**  
heavy biting



One surface cut and lifted

Possums will, on rare occasions, tear the upper surface (with upper incisors) of the card during vigorous biting. These tears are broad but usually don't reach the card margin.

**Possum:**  
premolars



Numerous non-diagnostic bite marks are produced by possums, particularly by premolar teeth near card corners. These non-diagnostic marks do not invalidate a possum identification.

**Possum:**  
angled chewing (side-on)

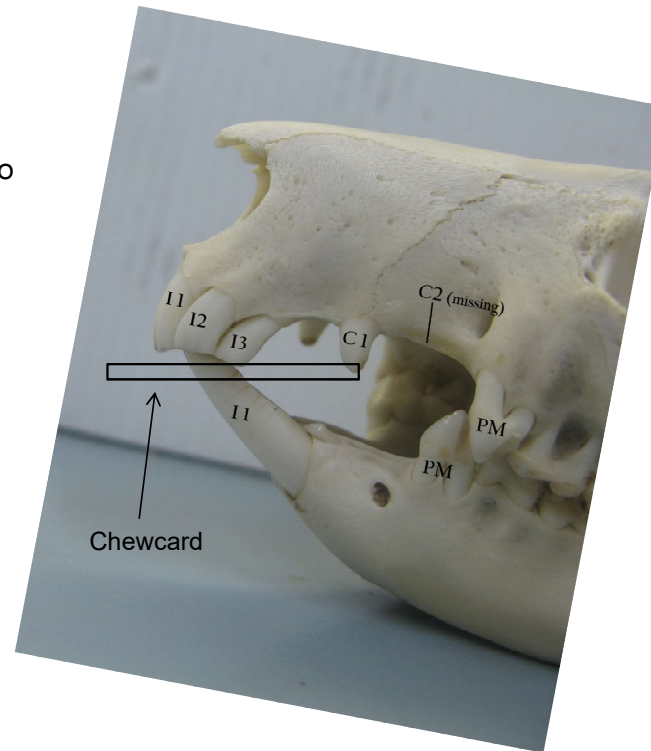


Possum biting while its head is oriented at an acute angle to the card margin also produces atypical marks. Only one tooth has been (largely) engaged on this particular card.



## Possum: angled chewing (up-down)

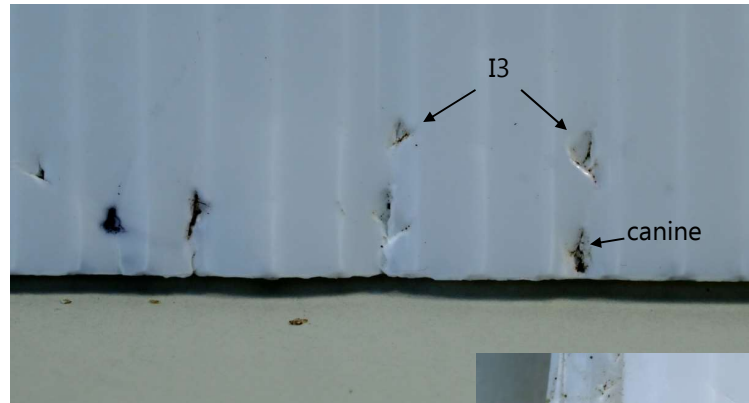
- Head tilted back relative to card
- Upper I1s not in contact with card
- I3 and C1 in contact with card
- Lower incisors are in contact with card



With the head tilted back during chewing, a further range of atypical marks can be made by possums, missing the upper I1s (first incisor teeth) but engaging the I2, I3 and canine teeth.



**Possum:**  
angled chewing (up-down)



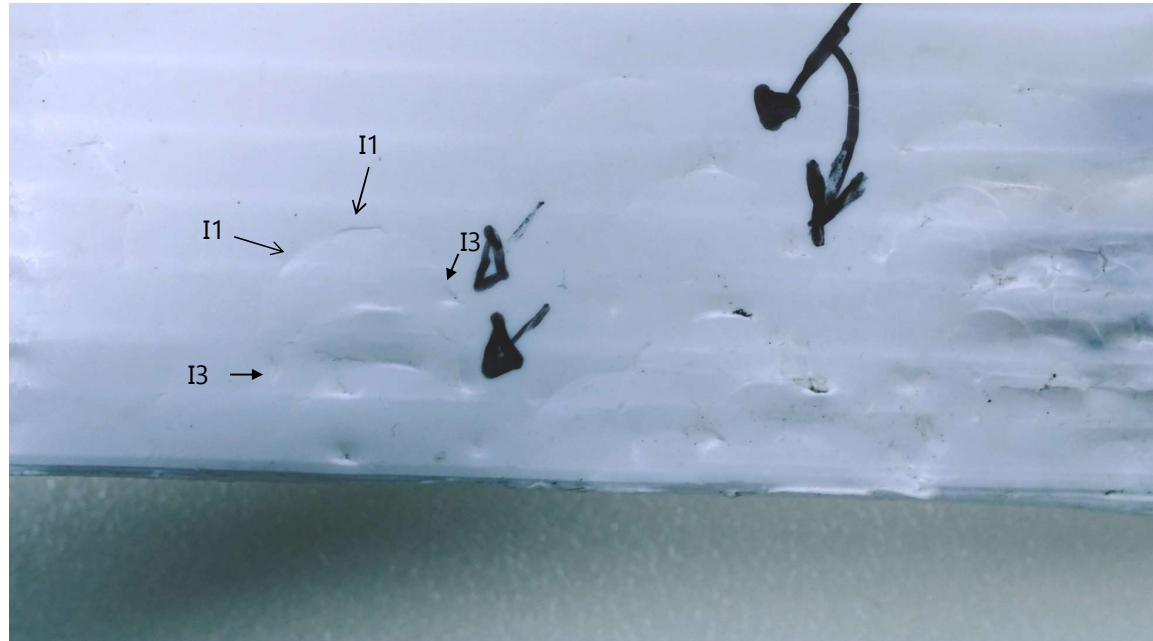
Few or no incisor-pair impressions on top (*lower incisor-pairs still present*)



With the head tilted back during chewing a further range of atypical marks can be made by possums, missing the upper I1s (first incisor teeth) but engaging the I2, I3 and canine teeth.



**Possum:**  
angled chewing (up-down)



With the head tilted back during chewing a further range of atypical marks can be made by possums, missing the upper I1s (first incisor teeth) but engaging the I2, I3 and canine teeth.

**Possum:**  
angled chewing (up-down)



With the head tilted back during chewing, a further range of atypical marks can be made by possums, missing the upper I1s (first incisor teeth) but engaging the I2, I3 and canine teeth.

## Summary: Identifying possums



- Look for extensively crushed (but not cut or holed) margins.
- Confirm by identifying 5–6 (4–7)mm wide incisor-pair tooth impressions (with medial notch).
- Don't be put off by apparently pointed teeth marks within crushed areas.
- In absence of crushed margins, look carefully for isolated incisor-pair impressions (**they may be very faint**).

## Common misidentified 'possum scores'



### **Animals that can produce possum-like marks:**

- Hedgehog: crushing
- Rabbit/Hare: crushing, incisor impressions
- Kea: crushing, lower beak impressions
- Rat: crushing (rare), incisor impressions

Several species of wildlife are capable of making bite marks that can be confused with possums; see the descriptions and slides for these four species (below).

## Rodents



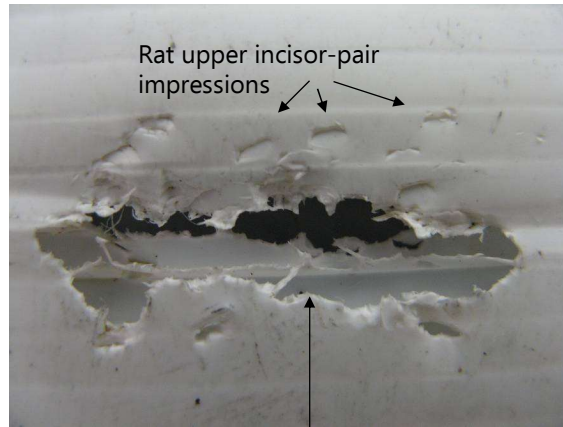
Rat skulls

Rat and mouse dentition is essentially the same, differing only in size

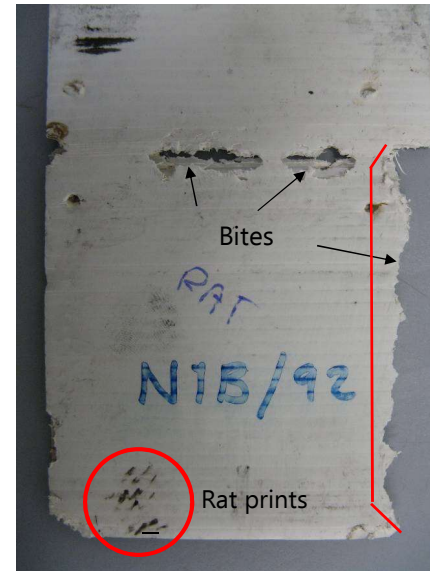


The large incisor teeth produce diagnostic bite marks in rodents. Only I1 incisor teeth are present, and the molars are well back in the jaw, therefore only incisor-pair impressions are made.

# Rat



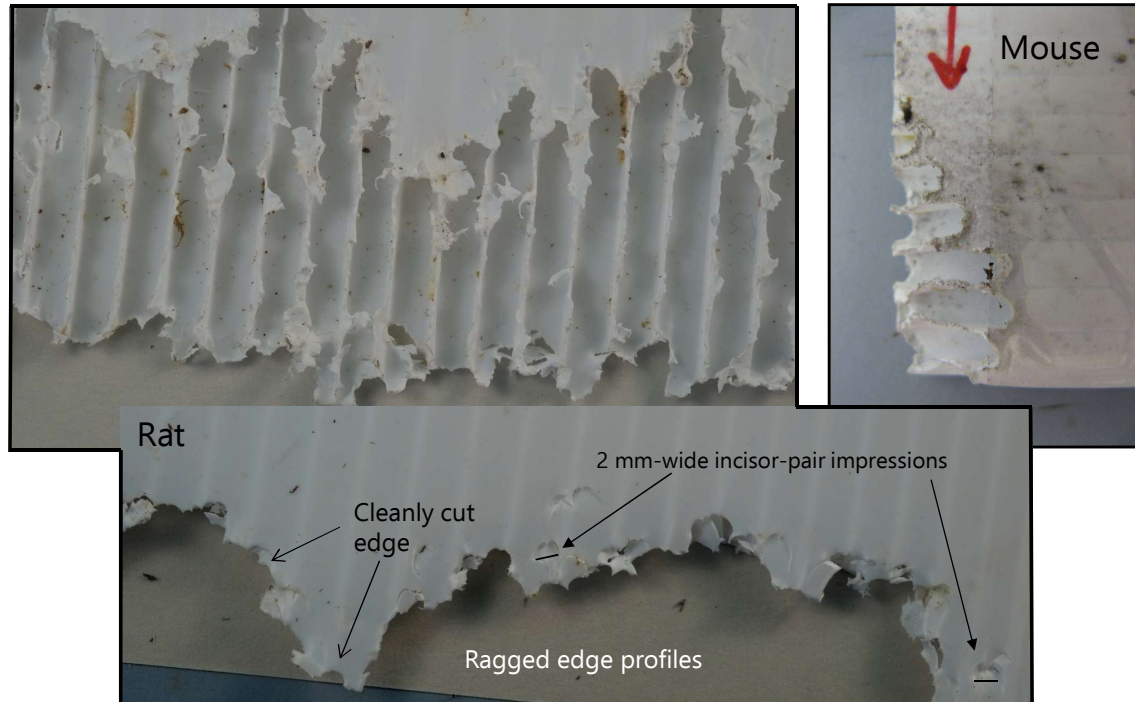
Ragged profile but usually cleanly cut edges



Rats typically remove large parts or all of the baited portions of the card.

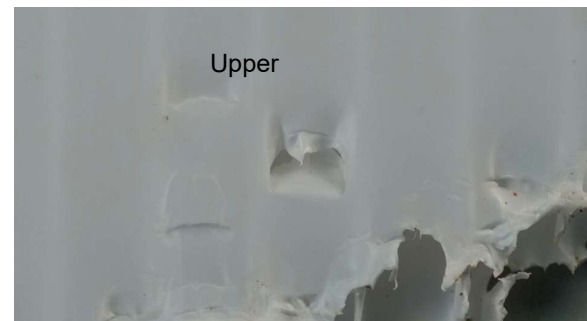
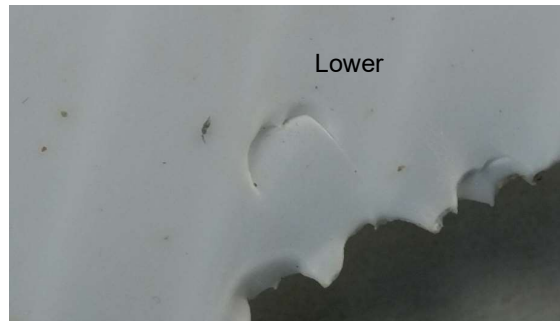
Typical rat sign on chewcards: large chunks of the card are removed, leaving jagged edges.

# Rat



Key rat diagnostics are the ragged profile of cut edges and incisor-pair impressions or holes about 2 mm wide. Note: mice leave much smoother cut edges.

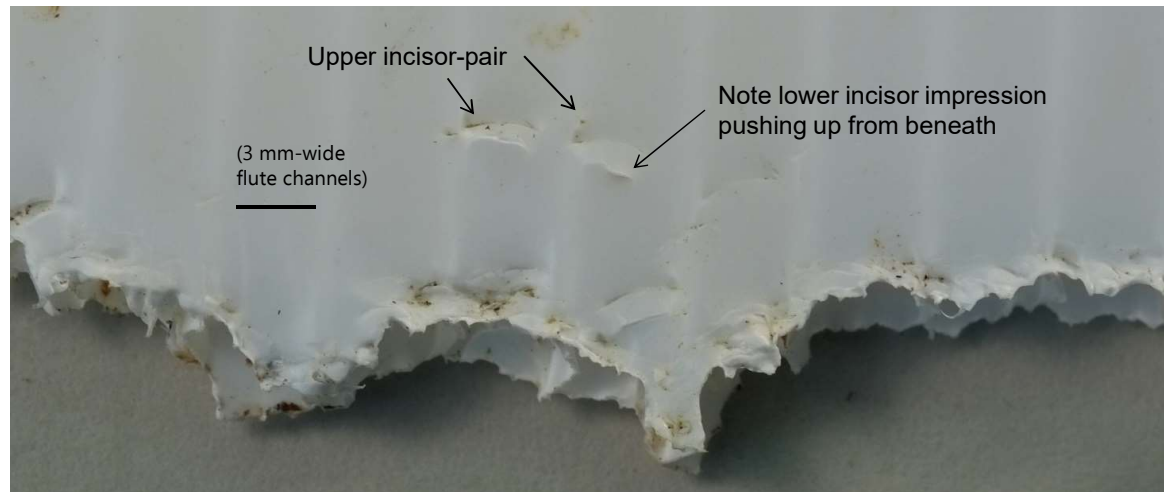
**Rat:**  
typical incisors



Lower incisor pairs are much more curved than the upper incisor impressions (rats and mice). Rodent incisor impressions can be very similar to those of possums, but are readily distinguished from possum by their much smaller size (2mm for rat and 1 mm for mouse incisor pairs).

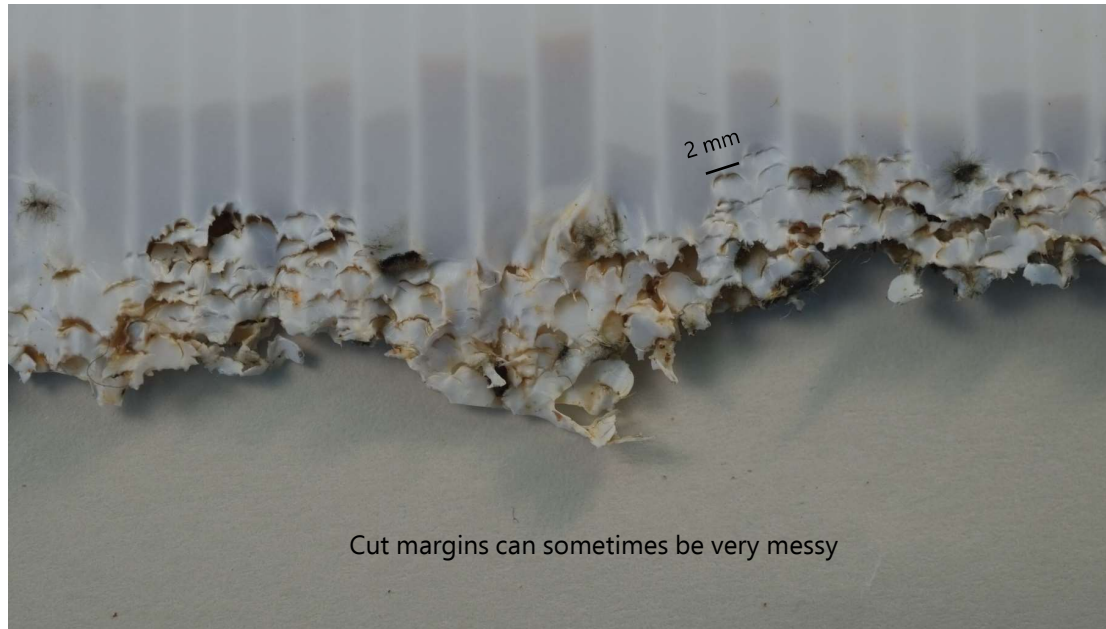


**Rat:**  
Incisor impressions



Key rat diagnostics are the ragged profile of the cut margins and incisor-pair impressions or holes about 2 mm wide.

## Rat

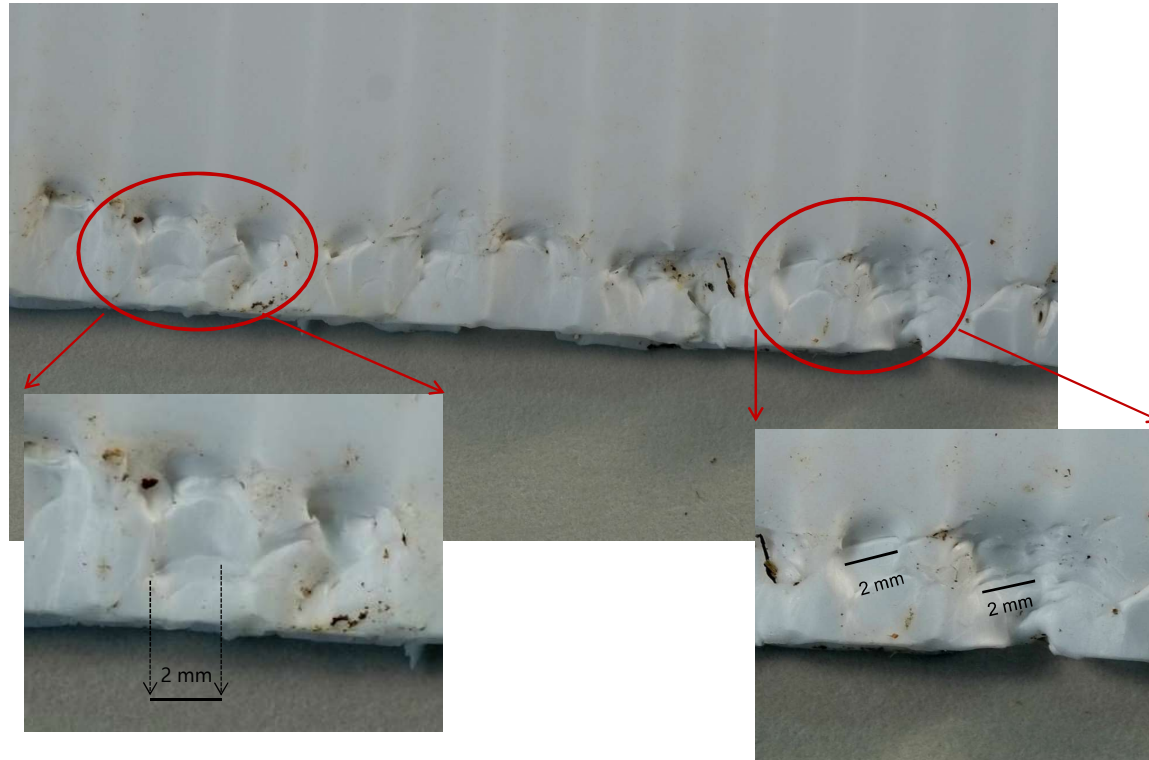


Cut margins can sometimes be very messy

Cut edges are not always cleanly cut. Here the margin of the cut-away area is banded by extensive incisor impressions, cuts and holes.

**Rat:**

atypical margin, crushed not cut



Rats can occasionally crush the card margin, appearing similar to a narrow band of crushing by possums. Crushed zones need to be carefully searched for incisor-pair impressions to measure and confirm identification.

**Rat:**

with 'false' possum bites....

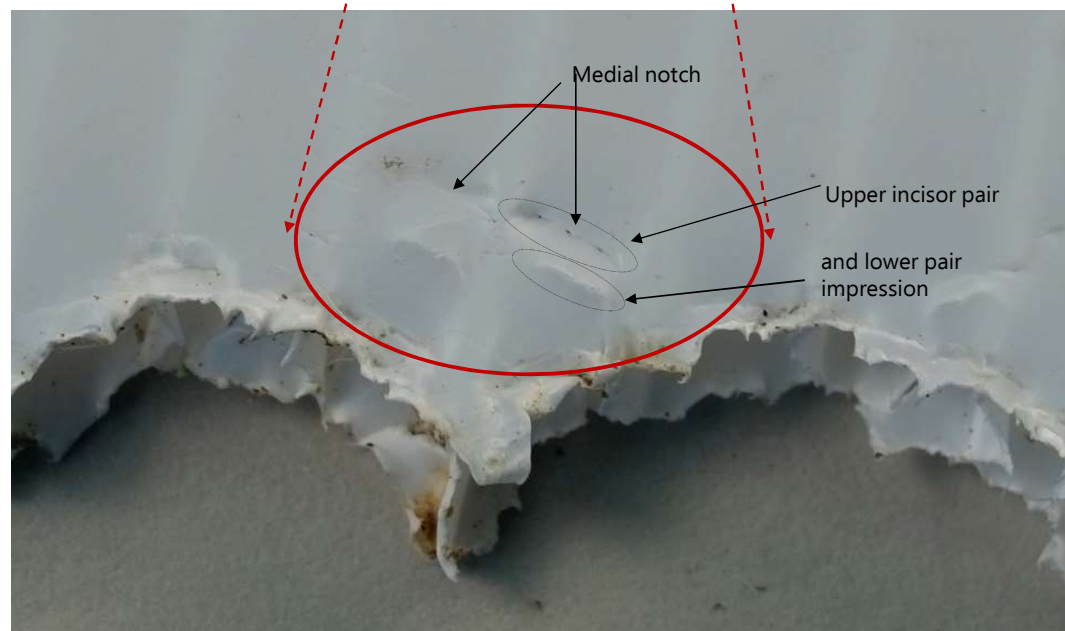


*Go to next slide...*

A pair of rat bites, side by side, can look like a single possum incisor-pair impression with a large medial gap. Each red circle represents a single 'false possum bite'.

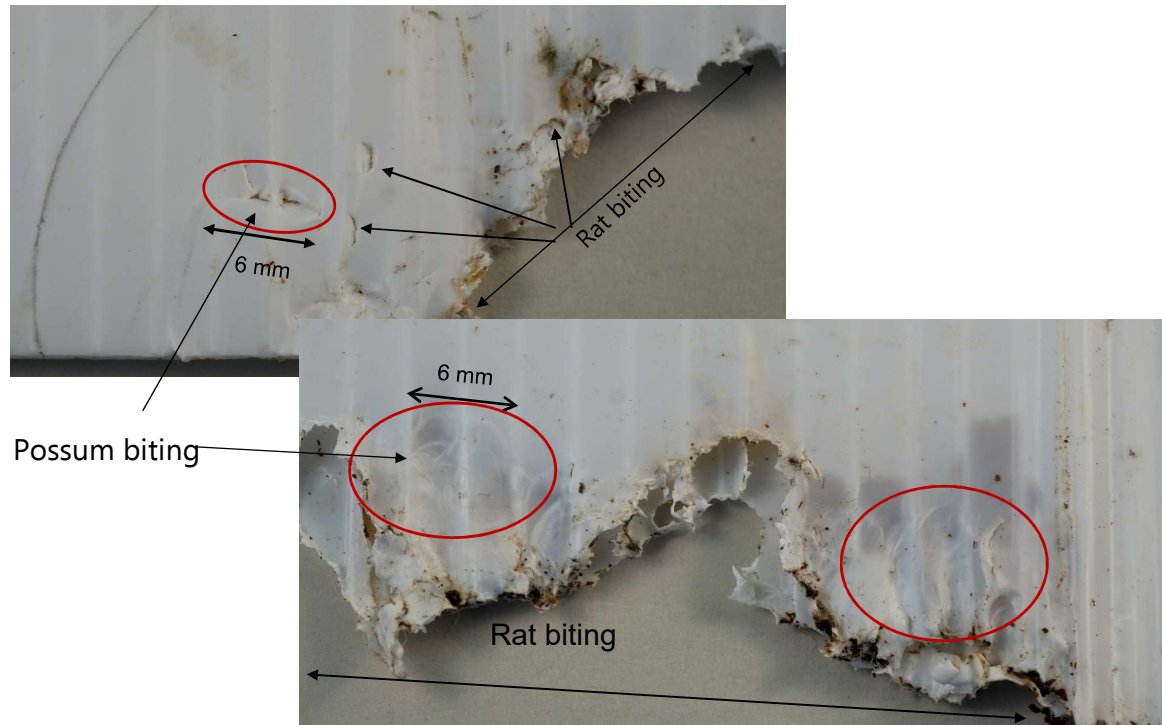
Use a good lens to pick up the fine details of a pair of rat bites within each circle (see next slide).

**Rat:**  
'false' possum bites cont.



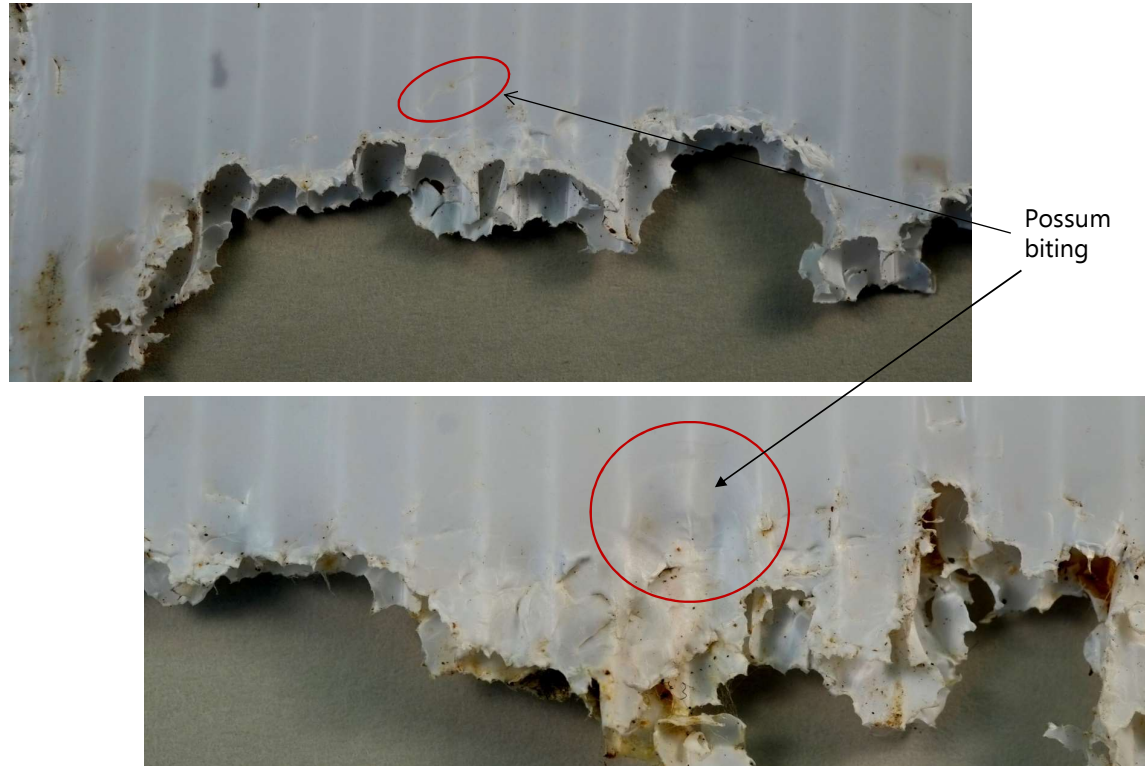
Close inspection of the incisor details reveals side-by-side rat bites, each with a medial notch, and not a single possum bite. Note also the reverse impression (bump) made by the lower incisors pushing up from below (a feature never seen with possums)

## Rat: with light possum bites



Cards clearly bitten by rats still need careful inspection to determine if a second or third species has also bitten the card. Here there is some possum biting as well.

**Rat:** with *very* light possum bites



Cards clearly bitten by rats still need careful inspection to determine if a second or third species has also bitten the card.

## Mouse

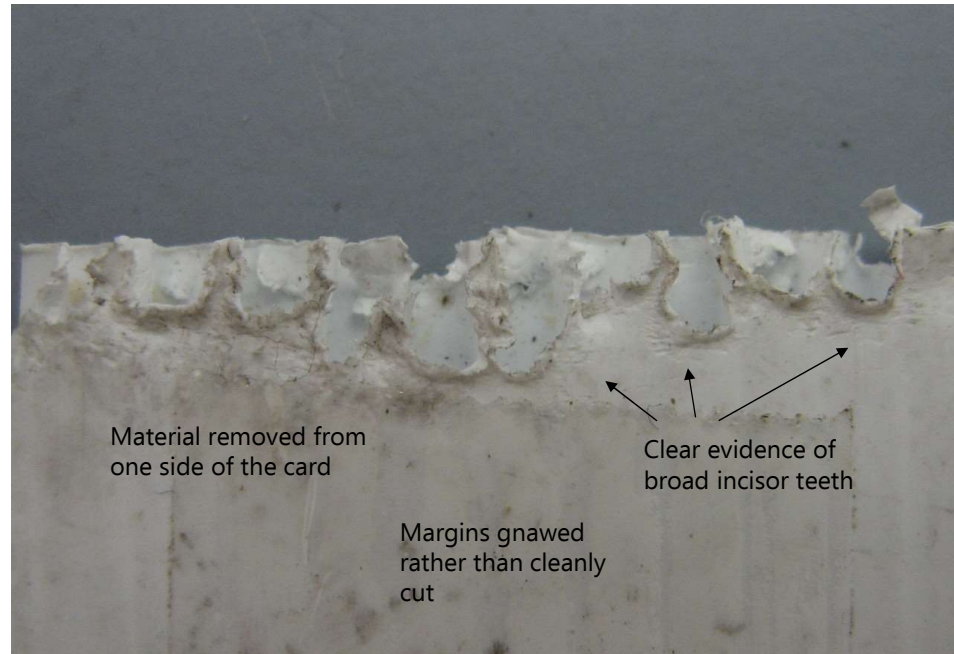


Typical chewing between channels, mainly on one surface only

Gnawed edge lacks the jagged profile produced by rats, but the cut edges are bordered by a band of heavily chewed material.

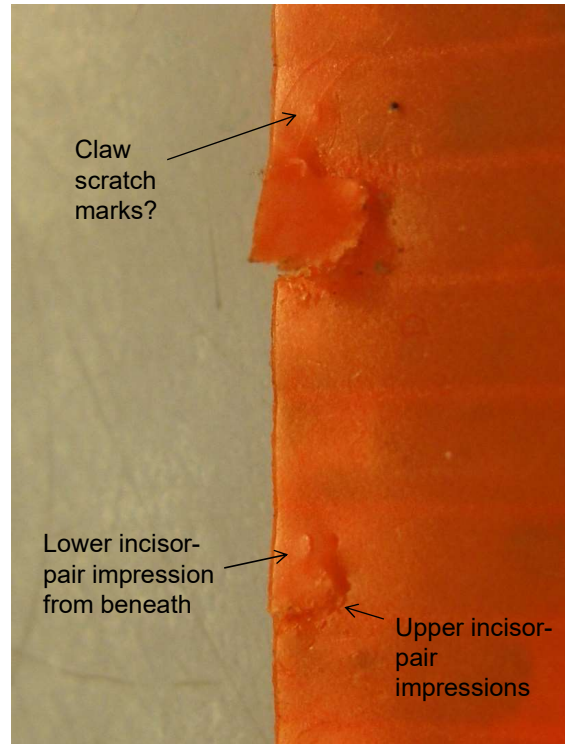


## Mouse



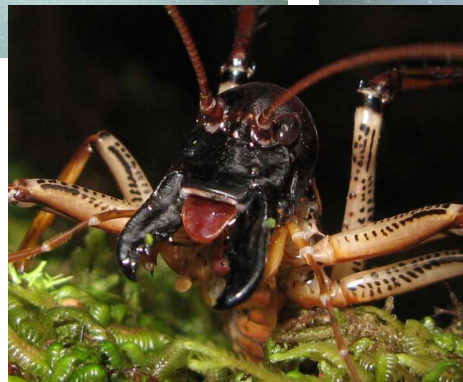
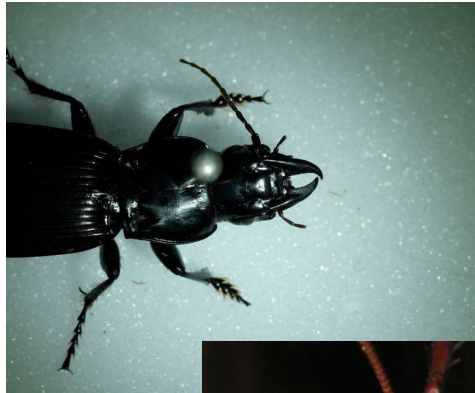
Even though the profile of mouse cut edges is smooth compared with the jagged edges left by rats, these mouse edges are messy, with a band of heavily chewed material along them.

## Mouse: margin 'nick'



Mice frequently also leave short cuts at the card margin. Invertebrates can make similar small nicks, so look for distinctive incisor-pair impressions of mice.

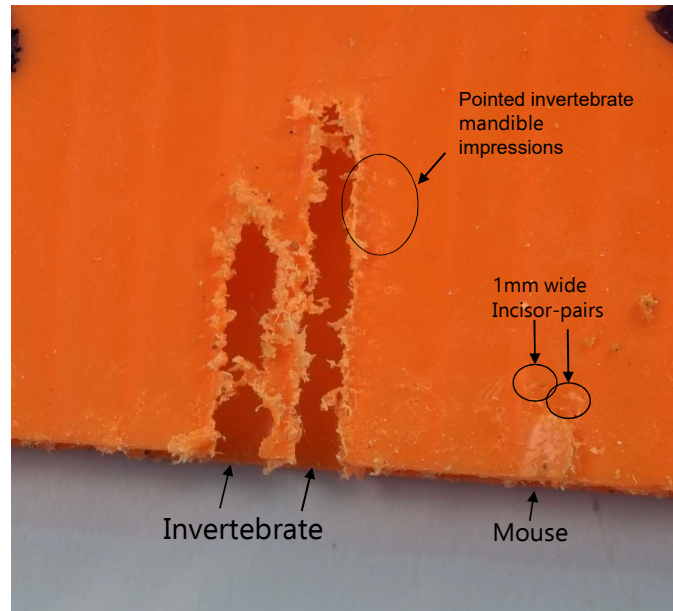
## Invertebrate



Invertebrate mandibles:  
sharp or rounded  
opposing points

Invertebrates that interact with chewcards have large mandibles with pointed ends. They will usually produce single, small, rounded impressions on the upper and lower surface of the card, although paired or double impressions can be made (e.g. the stag beetle at top right).

## Invertebrate



Very ragged margins and pointed mandible impressions

When removing card material, invertebrates produce very ragged edges on a very fine scale, unlike the much smoother profile produced by mice.

## Invertebrate

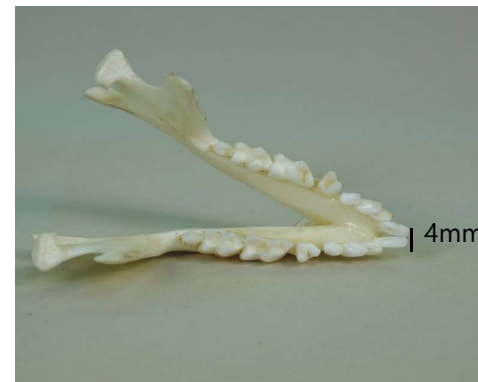


When removing card material, invertebrates produce very ragged edges on a very fine scale, unlike the much smoother profile produced by mice.

## Carnivores: Hedgehog



- Prominent canines in skull
- Blunt incisor-pair in jaw

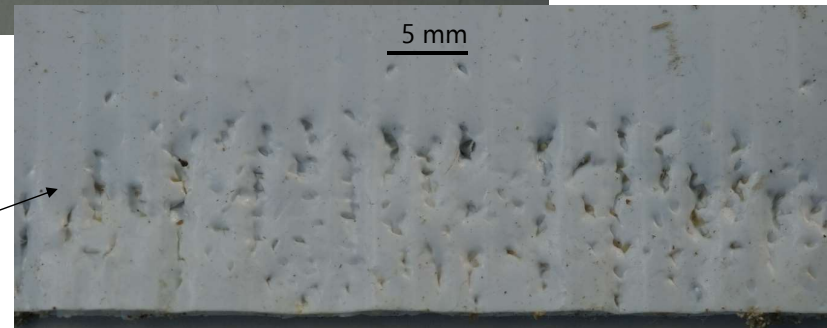


Hedgehogs have a couple of prominent canines in the skull and two prominent and usually blunt incisors in the lower jaw. Therefore, they produce very different tooth impressions on opposite sides of a chewcard.

## Hedgehog:



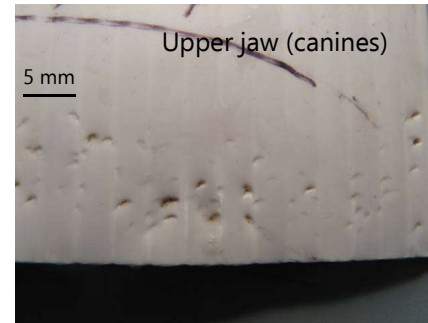
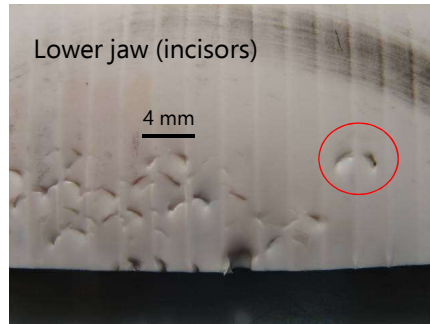
Mandible/lower  
jaw (incisors):  
possum-like  
crushing?



Upper jaw  
(canines)

Hedgehogs can crush one side of the card with blunt incisors while producing smaller and sharper impressions with canine teeth on the upper surface. Note that canine marks are oval, and both types of teeth are oriented at nearly right angles to each other within one pair.

## Carnivores: hedgehog

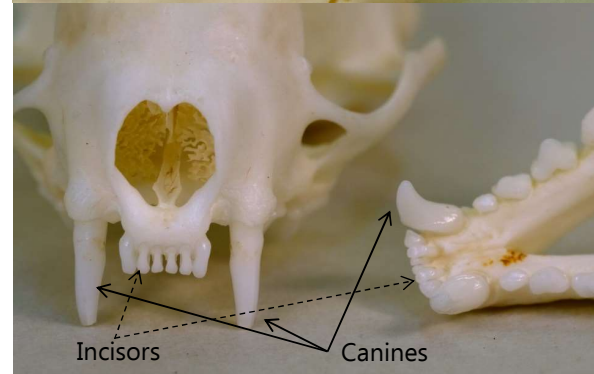
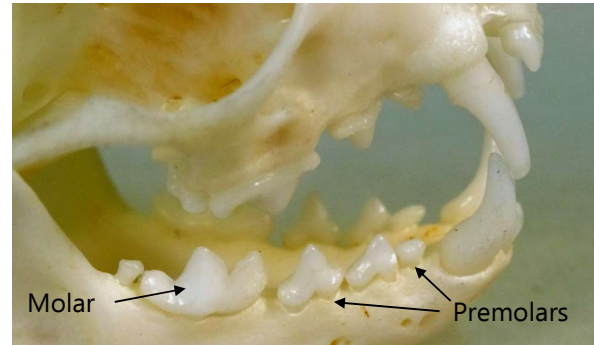
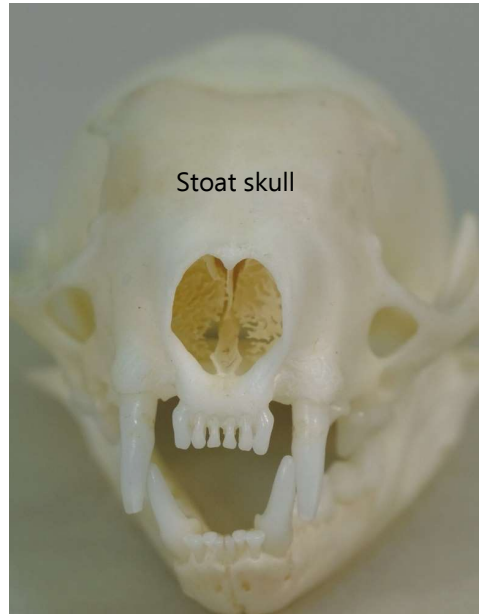


Hedgehogs produce blunt incisor-pair impressions on one side and sharper, more widely spaced impressions made by canine teeth on the other side.

Hedgehogs can crush one side of the card with blunt incisors while producing smaller and sharper impressions with canines on the upper surface. Note that canine marks are oval and both types of teeth are oriented at nearly right angles to each other within one pair.



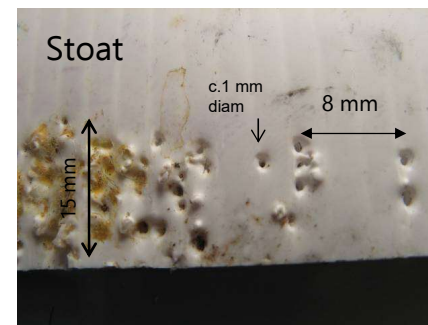
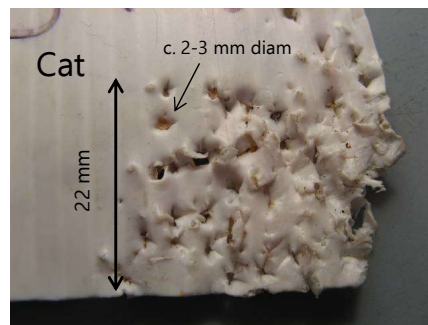
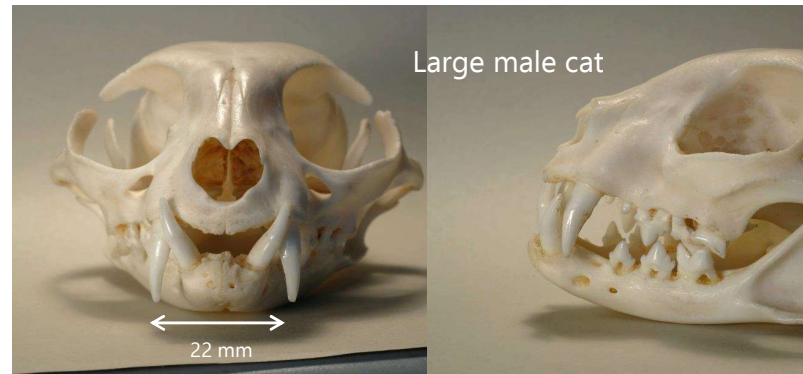
## Carnivores: mustelid & cat



- Prominent canines top and bottom
- Small incisors not diagnostic
- Sharp molars and premolars not diagnostic

Long, sharp, canine teeth are the diagnostic features of cats, dogs and mustelids. The small incisor teeth do not usually make marks on chewcards.

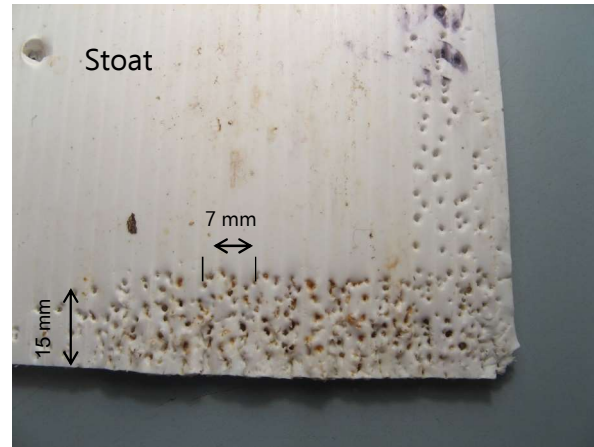
## Carnivores: cat & stoat



Skulls and jaws have large paired canines with small incisors between  
(missing in this cat skull)

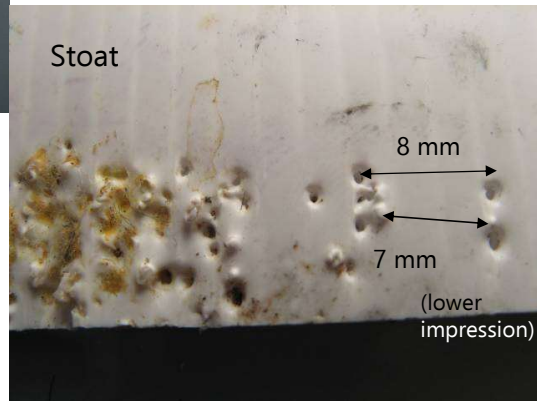
Canine impressions and hole diameters are variable within each species and individual, depending on depth of penetration and because the canines are splayed. The most accurate measures are taken from shallow bite marks (or the 'negative' bump/holes of upper canines where they mark the lower surface of the card). The incisors rarely leave any marks.

## Carnivores: mustelid & cat



Mustelids and cats produce paired, circular canine puncture marks, top and bottom

Species	Inter-canine distance
Weasel	4–6.5 mm
Stoat	7.0–9 mm
Ferret	10–14 mm
Cat	14.5–22 mm

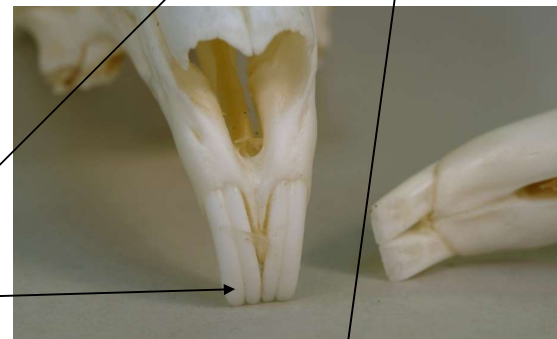


Upper inter-canine distances are measured for carnivores (centre to centre), where a canine pair can be identified. There is a limited amount of overlap between these species, so there is uncertainty at the range limits. Measurements in the table come from simulated impressions from wild-caught animals, including juveniles.

## Rabbit/hare



Paired incisors top and bottom  
(sharp and straight)

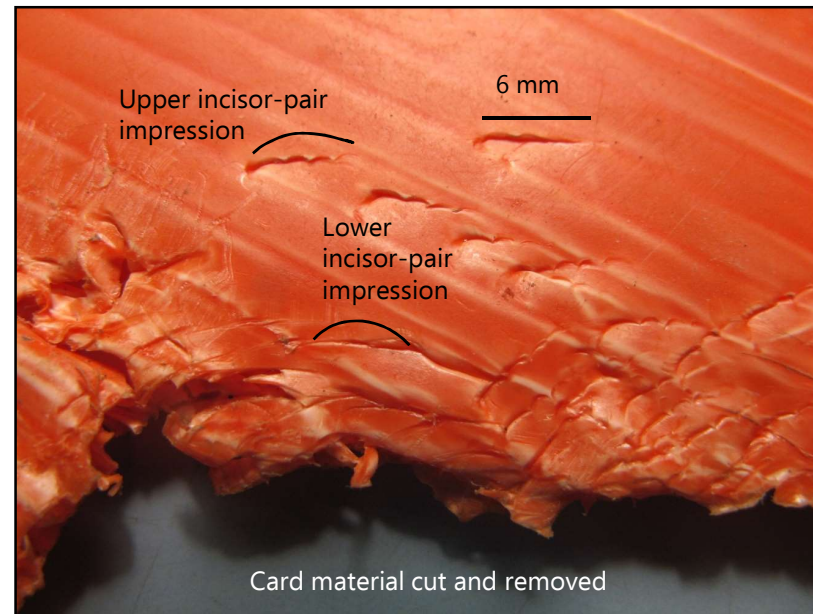


Upper incisors with longitudinal  
groove

No groove on lower incisors

Though similar in size and shape to possums', incisors of lagomorphs differ by having a longitudinal groove on the upper incisors, and the very straight lower incisors. Note rabbits and hares have similar-sized incisors and so cannot be separated by their bite marks.

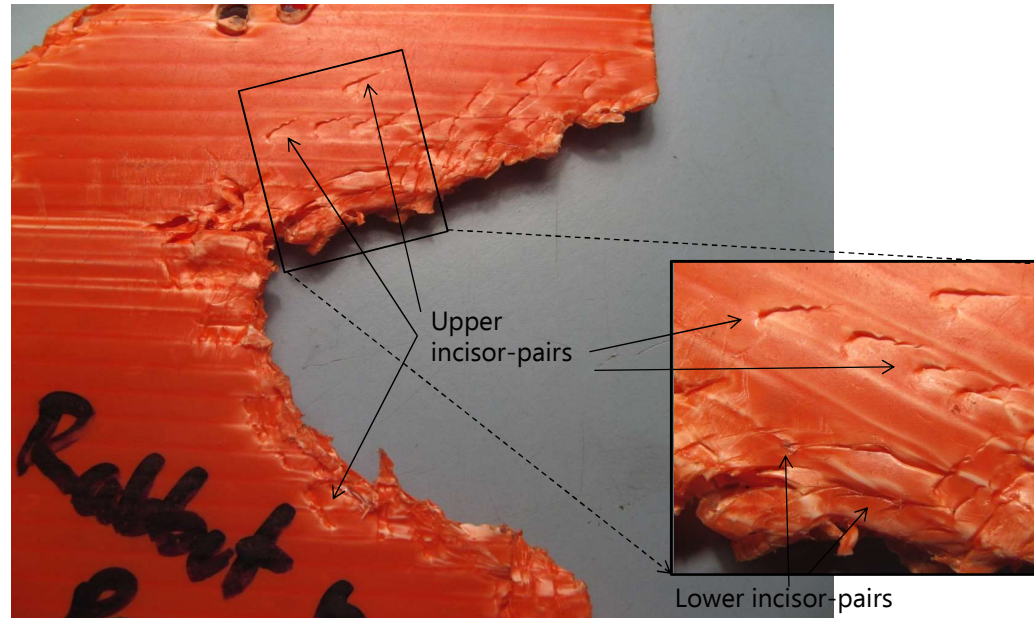
## Rabbit/Hare: (false possum bites)



Grooves on upper incisor teeth give the appearance of 4 small teeth in a row

Cut-away areas on hare/rabbit cards are also a diagnostic distinction between lagomorphs and possums, as are the four 'humps' of upper incisor pairs and the very straight lower incisor pairs (lower incisor pairs in possums are strongly curved).

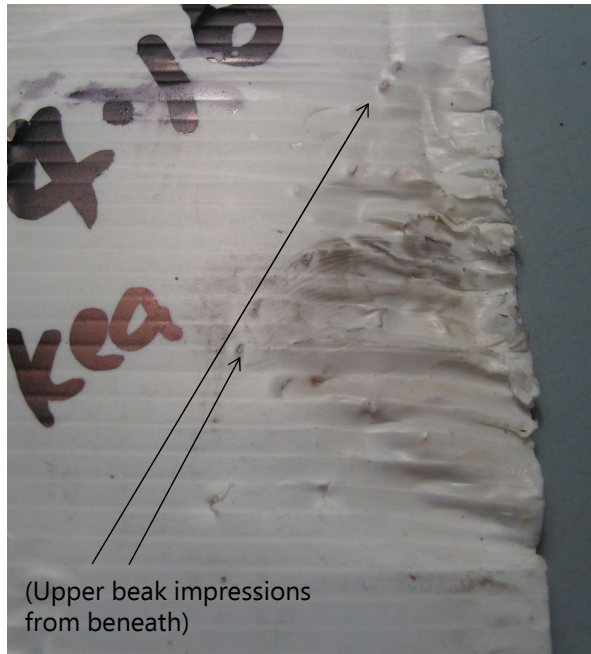
## Rabbit/Hare: (false possum bites)



Large areas cut from card surround a crushed margin with numerous distinct broad incisor tooth impressions. Upper incisors with central groove; lower incisors flat/straight and no groove.

Cut-away areas on hare/rabbit cards are also a diagnostic distinction between lagomorphs and possums, as are the four 'humps' of upper incisor-pairs and the very straight lower incisor-pairs.

## Kea: (false possum bites)



Lower beak: *possum-like*; **no medial notch!**



Upper beak: sharp, V-shape

Kea can produce crushing, and lower beak impressions similar to biting by possums. However, lower beak impressions do not have a medial notch and upper beak impressions are V-shaped and often sharp.

## Weka

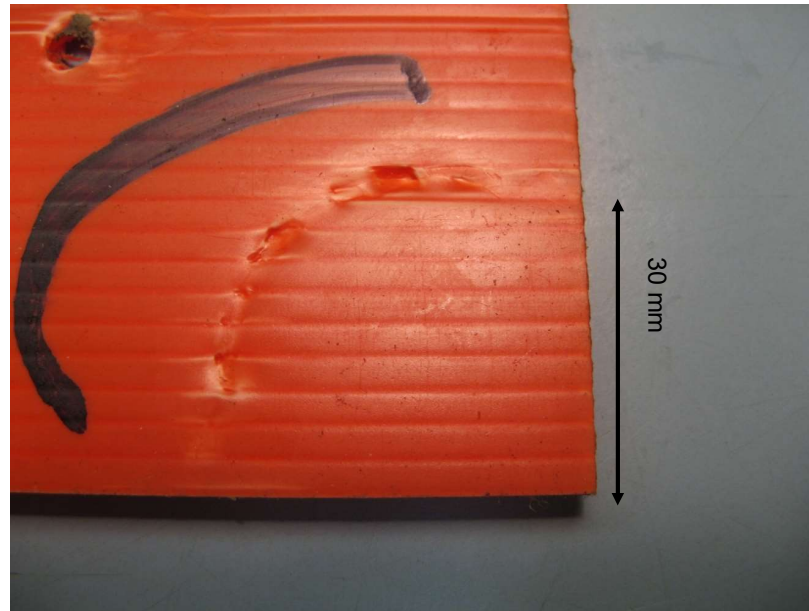


Randomly scattered variable depressions across the face of the card,  
c. 4 mm wide.

Weka make randomly scattered indentations, about 4 mm across, of variable shape across the card surface. They range from sharp impressions that can puncture the upper card surface, as pictured, to blunt, rounded depressions.



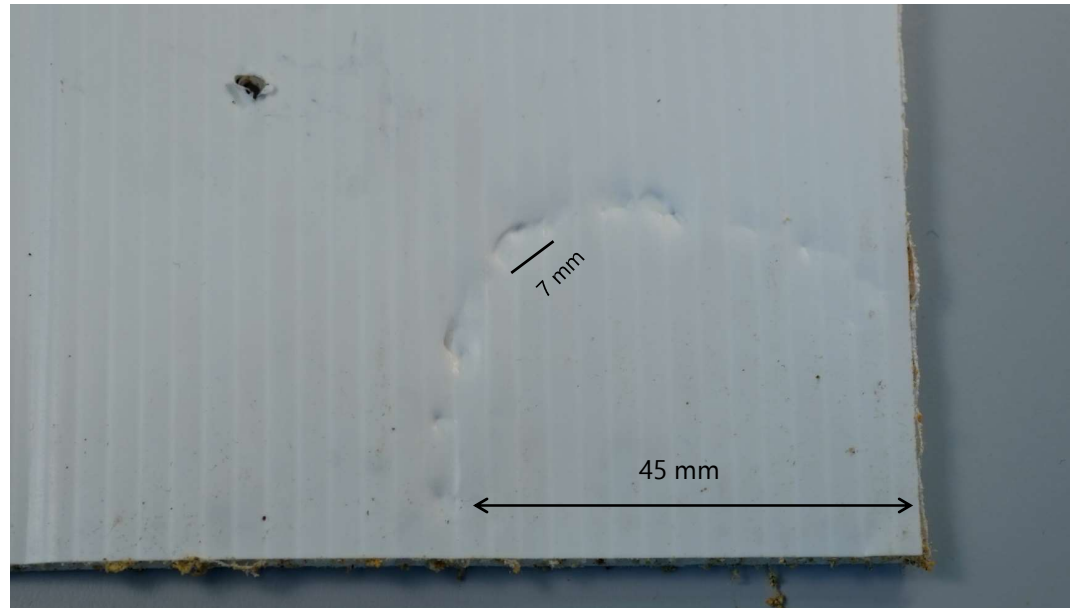
## Ruminants: Goat/sheep/cow/deer



Broad incisors on mandible; no teeth opposite incisors in upper jaw

Ungulates have four incisors in each lower jaw (up to 8 in total for a single bite mark). There are no incisors in the skull (upper jaw). Instead there is just a calloused pad. Therefore ungulate bite marks comprise an arc of up to 8 incisor impressions on one side of the card, and no impression, or just a shallow and indistinct dent or fold, on the opposite side.

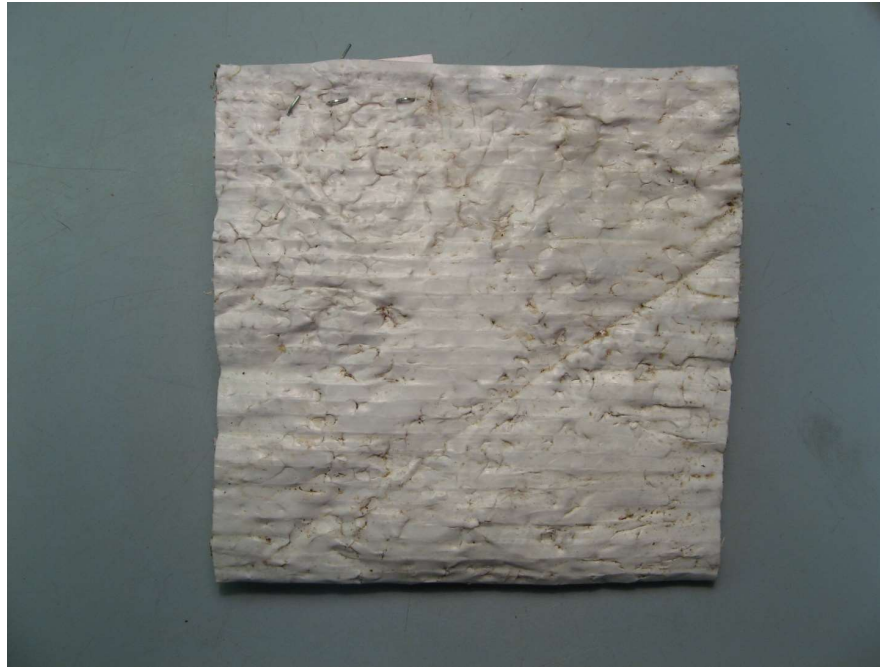
## Ruminants: Goat/sheep/cow/deer



Broad incisors on mandible; no teeth opposite incisors in upper jaw

Incisor arc sizes are variable depending on species, ranging from c. 20 mm in sika fawns (6 month old) to about 80 mm in cattle.

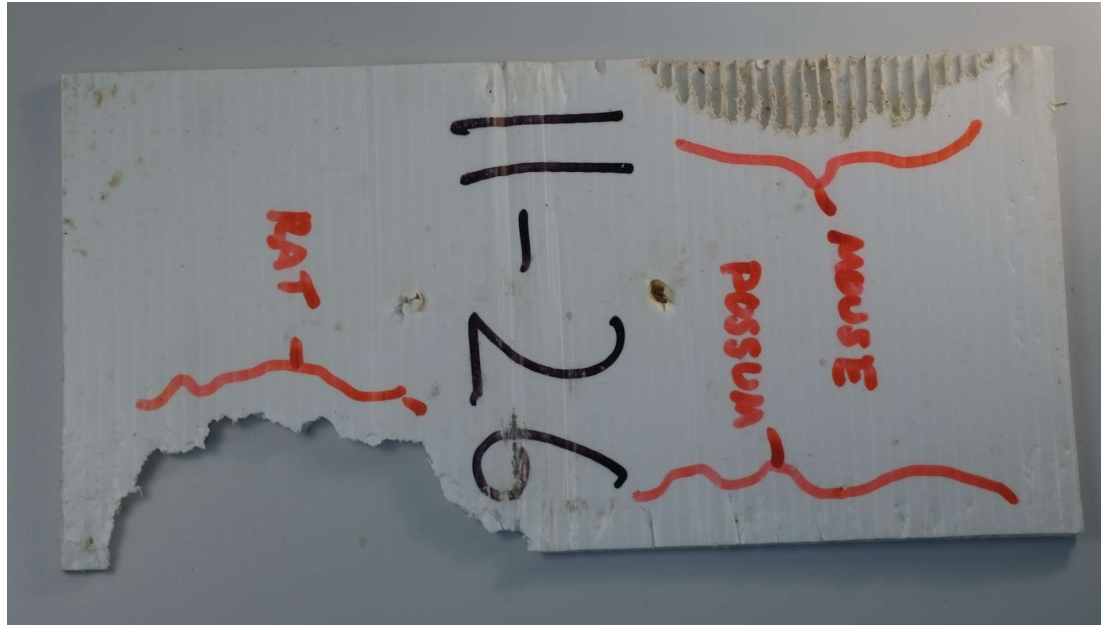
## Ungulates: Pig/cattle



Whole card has been taken into the mouth and extensively chewed

Large ungulates can take the entire card into their mouths and chew extensively, leaving a mass of indiscrete tooth impressions. This particular card was from a deep forest sites so was probably chewed by a pig.

## Multiple species



Cards can be chewed by multiple species.

Because there may be bite marks from more than one species on a single chewcard, all cards need to be searched completely even after one species' marks have been identified.