Bird Bones & Hungry Beetles

Using the Natural History Museum's modern skeletal collections to understand insect bone-eating patterns in ancient settings

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Background

Timing of arthropod wave arrival to a human corpse:

House Flies & Blow Flies
a few hours - 3 months

Rove beetles
First 72 hours-3 months

Dermestid (hide) beetles
3-8 Months

Clothes Moths
4-9 Months

When vertebrates (humans and animals with spinal cords) die, a variety of arthropods are drawn to the remains for food, shelter, reproduction, and to prey on other insects. Some arthropods are attracted to certain chemicals that come from body enzymes and microbes breaking down the soft tissues or causing decay. This makes them useful in forensics for determining the length of time since death. Dermestid beetles (or hide beetles) are among these forensically important insects. Museums and taxidermists like to use dermestids to carefully clean bone without damaging specimens.

Specimens with beetle damage

- **NHMUK S/2023.7.1**
  Platycercus icterotis (western rosella)
  Bred & died in captivity, 11 weeks old (mature at 1 yr)
  Into colony:15 June 2017. Out of colony:6 July 2017
- **NHMUK S/2023.9.1**
  Otis tarda (great bustard), fresh weight 5 kg
  Age 6-7 months at death (mature at 1yr)
  Went into 3 tanks. Dates unavailable.
- **NHMUK S/2023.11.1**
  Alopochen aegyptiacus (Egyptian goose)
  Went into multiple tanks. Date No. 31 into colony: 7 September 2017
- **S/2023.16.1**
  Gyps rupelli (Ruppell's vulture)
  May have been in 2 tanks. Date No. 85 into colonies: 30 March 2017
- **S/2019.3.1** *Amazona oratrix, died in captivity*
  Into colony Nov 2017. No out date.
- **S/2023.13.1** *Uria aalge, wild bird.*
  Into colony 16 Jun 2020. Out of colony March 2021.
- **S/2023.12.1** *Anas georgica georgica/spinicauda, wild bird.*
  In 7 June 2019. No out date.

NHM Tring's Dermestarium

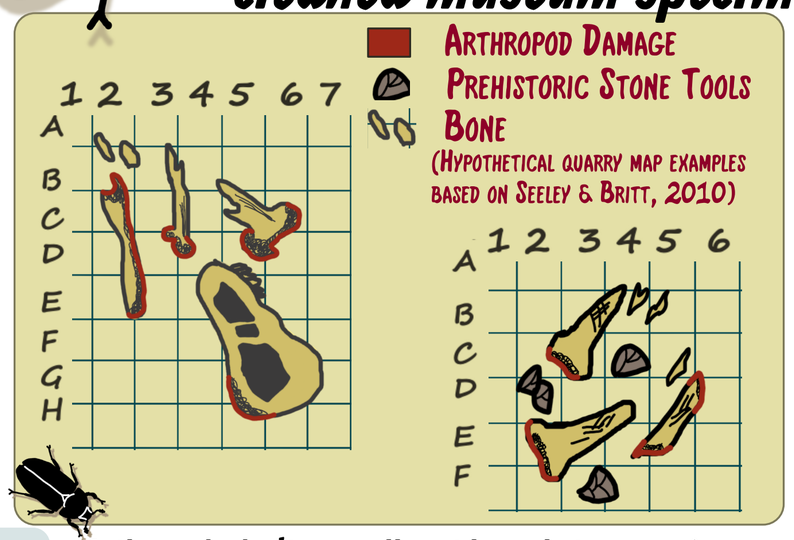
- *Colonies at NHM Tring have been maintained since the 1970s.*
- *They keep six dermestid tanks, two species (**Dermestes haemorrhoidalis** and **Dermestes maculatus**).*
- *Specimen processing records kept in log books. Museum's main goal is to optimize the time a specimen needs to spend in a tank to thoroughly clean off most of the flesh.*
- *Bones extracted from frass (bug poop), soaked in mild lab chemicals. To maintain bone structure stability, there is no bleaching or degreasing.* ***We can assume bone damage is most likely evidence of dermestid activity and not chemical dissolution.***

Study Objectives

1) Observe characteristics of damage on bone specimens from the Natural History Museum at Tring.

2) Use modern traces to better evaluate the effectiveness of existing fossil diagnostics and enhance interpretive power.

Why look at dermestid-cleaned museum specimens?



***Dermestes haemorrhoidalis* larvae and adult beetles snacking on raw chicken at the Botanic Gardens**

Arthropods don't normally eat bone, but on occasion they do! *Damage patterns or traces on museum specimens can help us understand similar bone traces in prehistoric settings. These traces give us clues about climate and the sequences of natural events in past environments. We can also learn about how archaeological sites were used by people in the past and how people looked after their dead.*

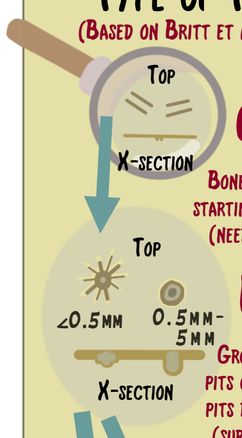
Challenges of Identifying Arthropod Traces

It can be challenging to tell the difference between arthropod traces and other things that can impact bone, both before and after death. The lesions on a prehistoric skull in Huchet et al. (2014) and, originally, Lortet (1907) were thought to be from disease. A closer look revealed the damage happened after death, and is likely to be from insect activity.

It can also be difficult to determine for certain which arthropods were the "trace-makers," because different genera can make similar kinds of marks.

Observations: Fossil vs. Modern Comparisons

Type of Trace
(Based on Britt et al., 2008)



Grooves
Bone damage is cumulative, starting with mandible grooves (need magnification to see)

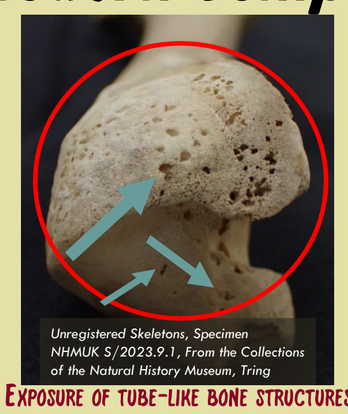
Pits
Grooves become small pits on the bone surface. Pits develop into furrows (surface channels) and borings (channels going inside the bone)

Furrows

Borings
Symmetrical burrowing, considered to be from larvae pupating (example of dermestid activity on a chicken femur at the Botanic Gardens)

Pits on Smilodon humerus from La Brea Tar Pits (BYU Museum of Paleontology)

Deep, hummocky furrows on sauropod bone from Dinosaur National Monument (BYUMP)



Unregistered Skeletons, Specimen NHMUK S/2023.9.1, From the Collections of the Natural History Museum, Tring

Exposure of tube-like bone structures called "trabculae" from surface pits (NHM Tring)

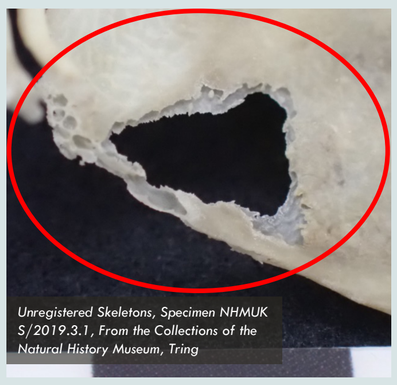
Unregistered Skeletons, Specimen NHMUK S/2023.9.1, From the Collections of the Natural History Museum, Tring

Surface furrows on thin bird bill (NHM Tring)

Unregistered Skeletons, Specimen NHMUK S/2023.9.1, From the Collections of the Natural History Museum, Tring

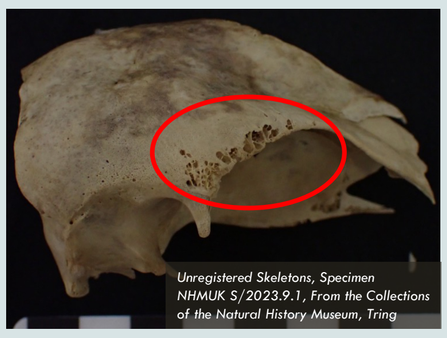
Asymmetrical burrowing (no symmetrical burrows found at NHM Tring)

Structures on Modern Bone obscured in ancient bone



Unregistered Skeletons, Specimen NHMUK S/2019.3.1, From the Collections of the Natural History Museum, Tring

Irregular bone edges with thinning or delicate layer separation



Unregistered Skeletons, Specimen NHMUK S/2023.9.1, From the Collections of the Natural History Museum, Tring

Delicate exposure of spongy trabecular bone structures along skulls, scapulae, and spinal ridges, as well as at the ends of leg and wing bones.

Conclusions

- *Traces in modern skeletal material offer more nuances than the existing fossil-based methodologies about the ways dermestids delicately remove bone layers and expose structures underneath. These nuances are not often discussed in detail from experimental studies in the current literature.*
- *Dermestids are delicate flesh consumers, it makes sense they would also be delicate bone consumers.*
- *Experiments are currently under way with a dermestid colony in Durham's Botanic Gardens to understand how these insects interact with bone as food vs. as non-food material or "substrate," and to understand the environmental pressures of bone boring as well as other damage patterns.*

References & Acknolwedgements

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