

**Is anyone here afraid of  
the dark?**















# Tarsiers: Tiny Terrors of the Tropics!





**Want to see one in action?**



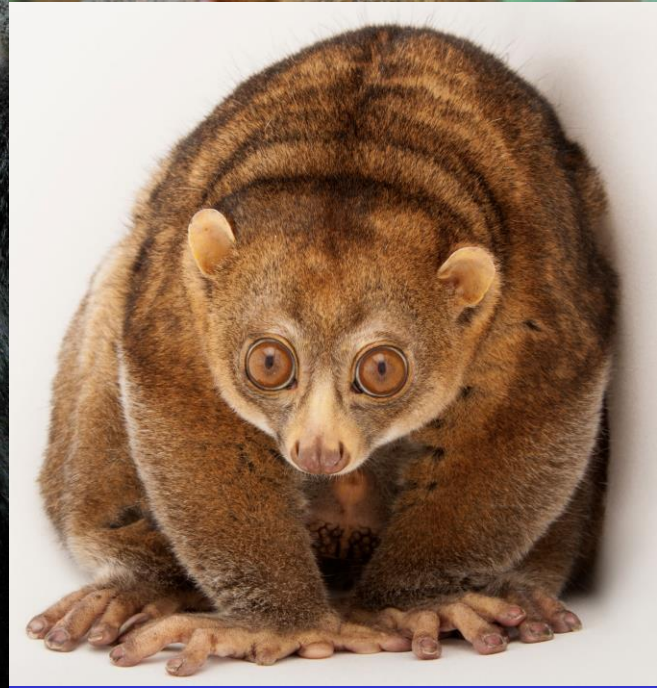
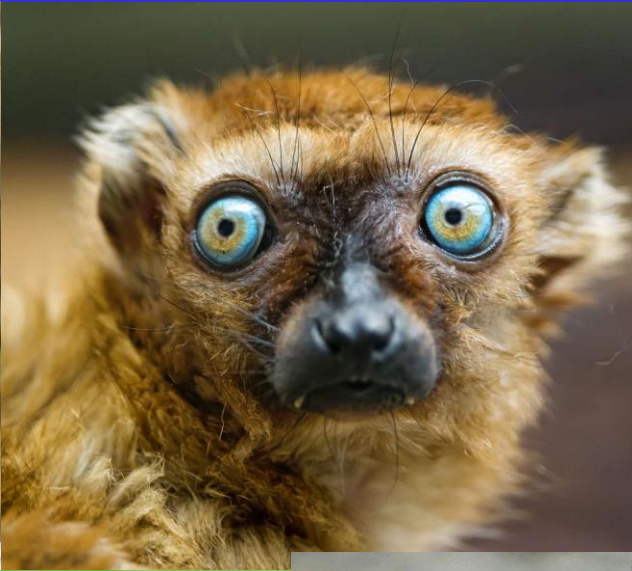
**Meet the tarsier!**



**One of the most interesting animals  
that most people have *never* heard of!**



# Tarsiers are Primates





**Tarsiers are only found...**





**Tarsiers are only found...**

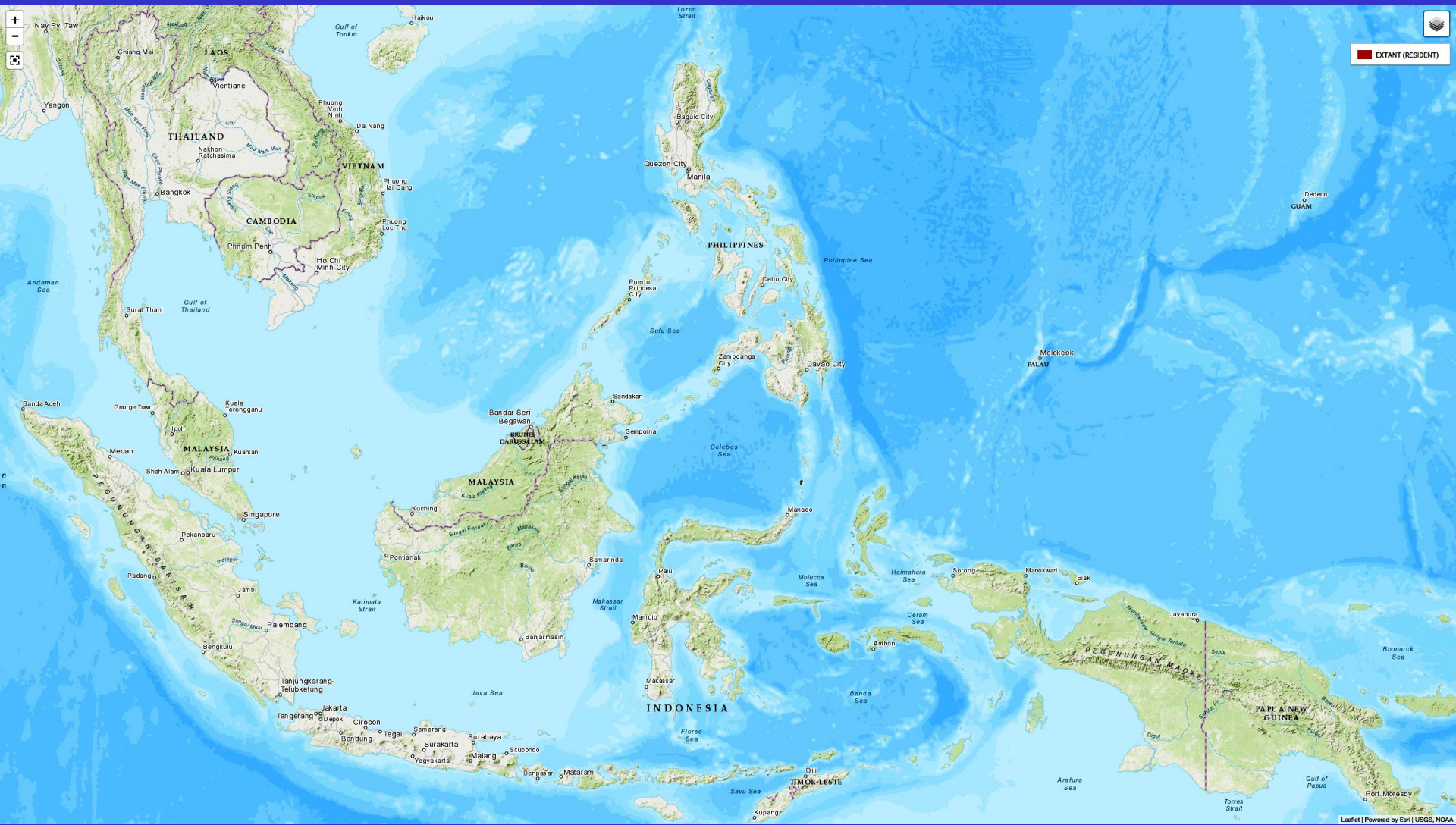


**Here  
in S.E.  
Asia**





EXTANT (RESIDENT)











EXTANT (RESIDENT)

**Philippine Islands**

**Malay Peninsula**

**New Guinea**

**Sumatra**

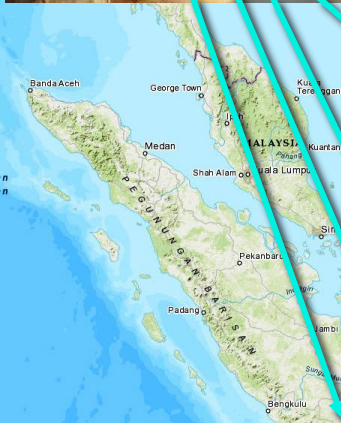
**Borneo**

**Sulawesi (Celebes)**

**Java**



**14 Species!**



**Latang Tarsier**  
*Tarsius lariang*

**Pygmy Tarsier**  
*Tarsius pumilus*

**Makassar Tarsier**  
*Tarsius fuscus*

**Spectral Tarsier**  
*Tarsius tarsier*

**Peleng Tarsier**  
*Tarsius pelengensis*

**Dian's Tarsier**  
*Tarsius dentatus*

**Wallace's Tarsier**  
*Tarsius wallacei*

**Philippine Tarsier**  
*Carlito syrichta*

**Jatna's Tarsier**  
*Tarsius supriatnai*

**Niemitz's Tarsier**  
*Tarsius niemitzi*

**Sangihe Tarsier**  
*Tarsius sangirensis*

**Siau Tarsier**  
*Tarsius tumpara*

**Gursky's Tarsier**  
*Tarsius spectrumgurskyae*



# Sulawesi is in a strange spot...

## The Wallace and Weber Lines







**Small: ~ 100-150g  
(0.22-0.33 lb.)**





Name “tarsier” derived from tarsus (ankle)



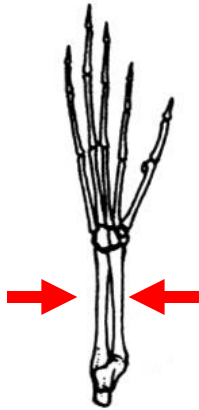
- Very long feet!



# - Feet huge due to 2 elongated ankle bones



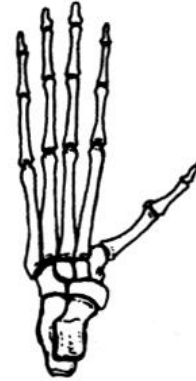
Slow Loris



Tarsier



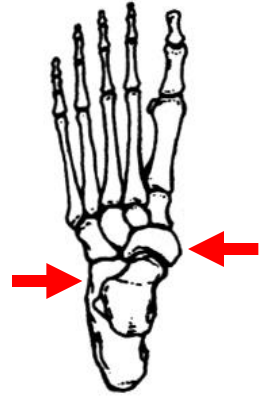
Macaque



Spider Monkey



Gibbon



Human







## Bornean Tarsier:

Head + body  
length:  
~ 150 mm

Foot length:  
~ 71 mm

Foot = 47% of head  
+ body length





**Prof.  
McConaughey**

**- Class of '93**

**- UT's Minister  
of Culture**





**Prof.  
McConaughey**

**Foot = 29% of  
head + body  
length**





**Prof.  
McConaughey**

**Foot = 47% of  
head + body  
length**





**Long feet &  
legs are  
adaptations  
for leaping**



**Tarsiers can  
leap more  
than 16 feet!  
(33 x head +  
body length)**



**Elite NCAA long jumpers ~ 22-27 feet  
(7-9 x head + body length)**





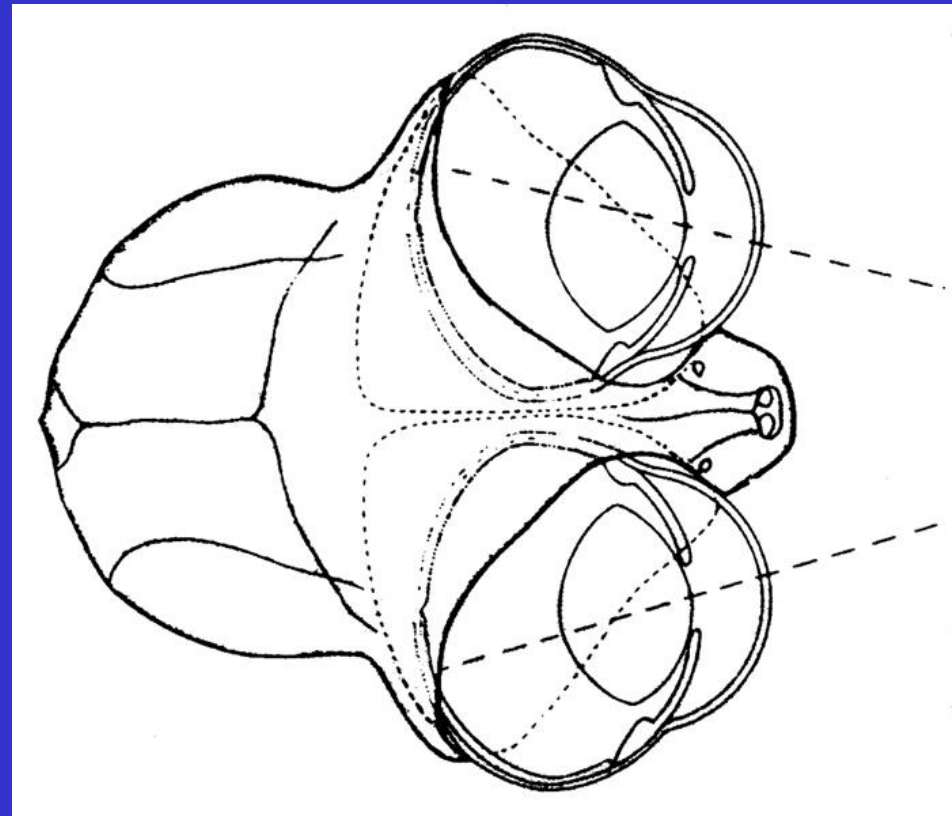
If humans could jump 33 x head body length:  
length: ~ 100 feet



- Relative to head and body size, tarsiers have the largest eyes of any living mammal



- Tarsier head length: 40 mm  
- Tarsier eye length: 18 mm  
(45% head length)



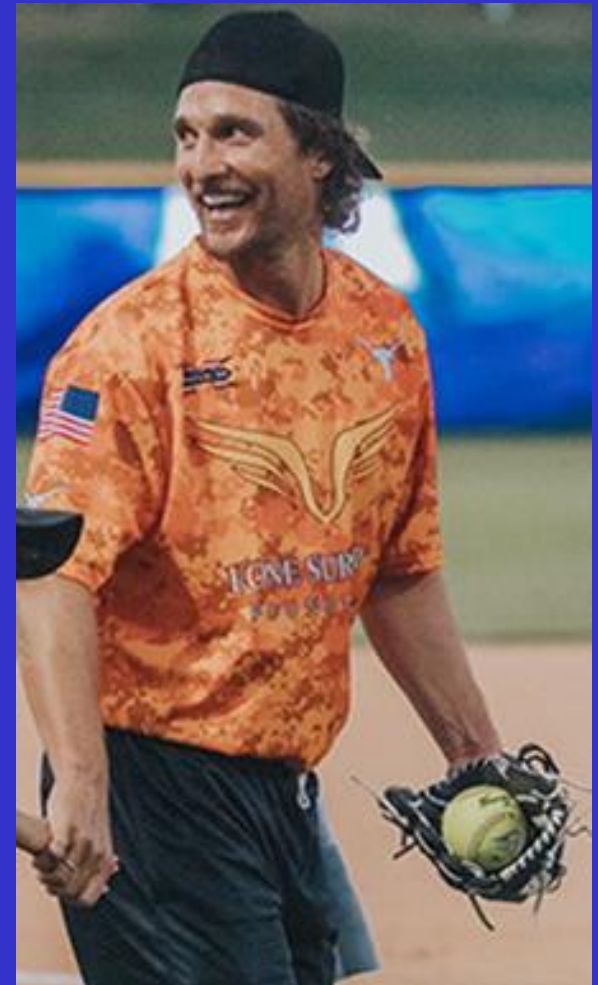




- Human head length:  
200 mm
- Human eye length:  
24 mm  
(12% head length)

- If humans had eyes  
45% of head length: 90 mm
- Baseball: 75 mm; Softball:  
97 mm

- I just *happen* to have a picture of Prof. McConaughey with a softball...





- I just *happen* to have a picture of Prof. McConaughey with a softball...





- I just *happen* to have a picture of Prof. McConaughey with a softball...





- I just *happen* to have a picture of Prof. McConaughey with a softball...



**Diet 100% animals, mainly insects**





# Tarsiers have sharp, pointy teeth



- Well adapted to dispatch and slice up insects

**Very big hands and long fingers**





# Here's an old tarsier skeleton in the Anthropology teaching collection:



Tarsius fraterculus ♂  
Tagbilaran Bohol  
April 1939 Philippines

Ward's Natural Science Establishment, Rochester, N.Y.

I also just *happen* to have a photo of Prof. McConaughey showing his hands...





I also just *happen* to have a photo of Prof. McConaughey showing his hands...



# Huge hands used to snatch prey...



Jürgen Freund Photography







**Scientists  
used to  
think that  
all tarsiers  
were  
solitary**





**Some  
species  
solitary,**

**Some  
species  
pair- or  
group-  
living**



**Infants carried in  
mouth and “parked”  
while parent(s) hunt**





**Like all primates,  
infants take a long  
time to mature**

- Gestation ~ 6 months
- Weaning ~ 80 days  
(rat ~ 22 days for both)





**When tarsiers were first discovered,  
*no one* knew what to think...**



**Georg Kamel  
1706:**

**Monkey?**



**Christian Erxleben  
1744-1777**

**Lemur?**



**Comte de Buffon  
1765**

**“Le Tarsier!”**





## Buffon:

**“We have obtained this animal by chance and from a person who could tell us neither where it came from nor what it was called; but it is very remarkable for the excessive length of its hind legs... it is from this very noticeable characteristic that we have derived its name.”**

**Buffon: Maybe *le tarsier* is some kind of jerboa (rodent)?**



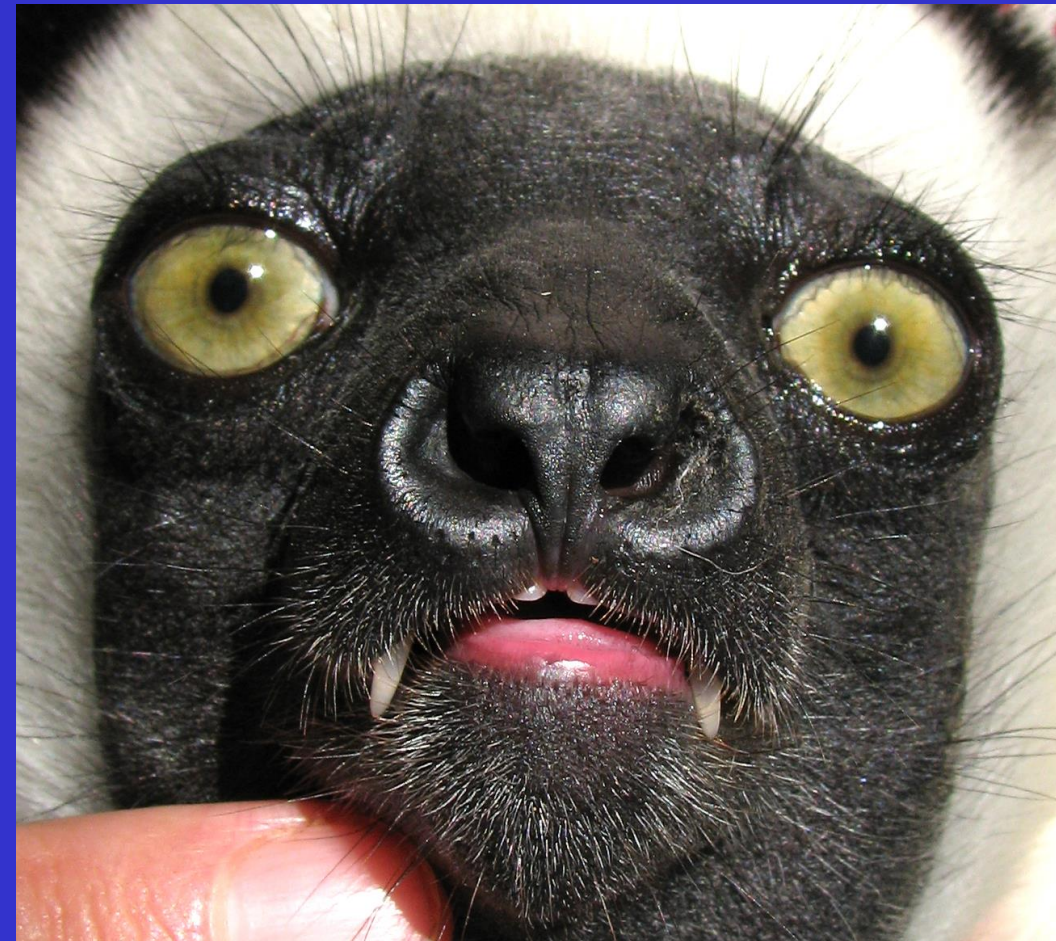




1918: Have you  
ever noticed that  
tarsiers have  
dry noses??

Reginald Pocock

**Some primates (e.g., lemurs) resemble other mammals in having a wet, hairless nose (“rhinarium”) & split upper lip**



**Lemur (sifaka)**



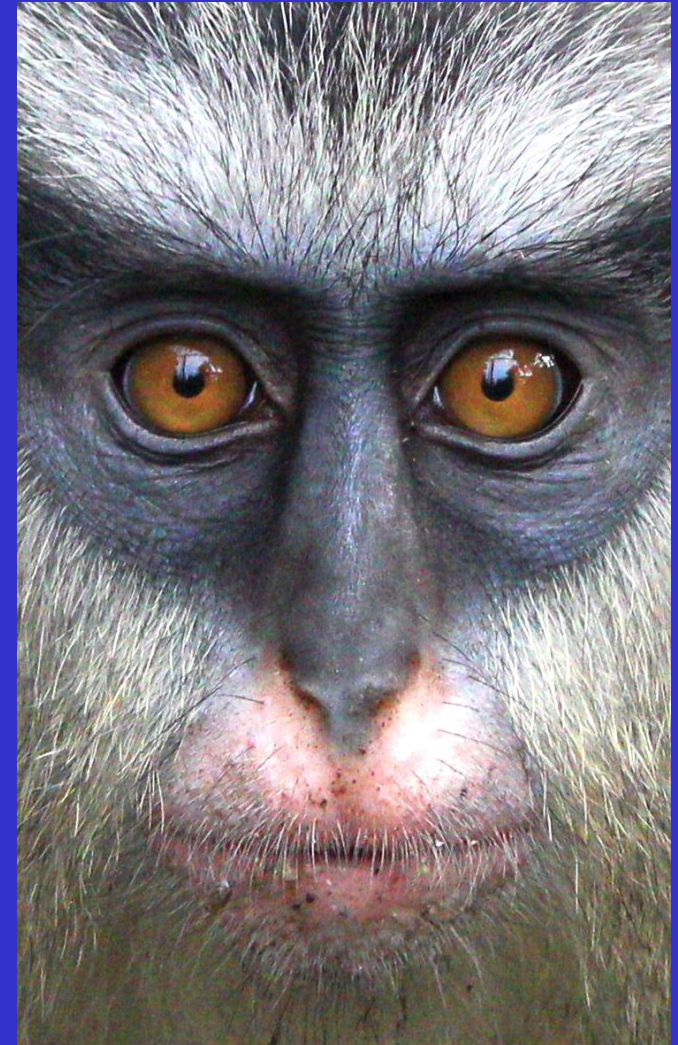
**Non-primate (dog)**



Like monkeys, apes, and humans,  
tarsiers have a dry nose and *lack* a rhinarium



tarsier

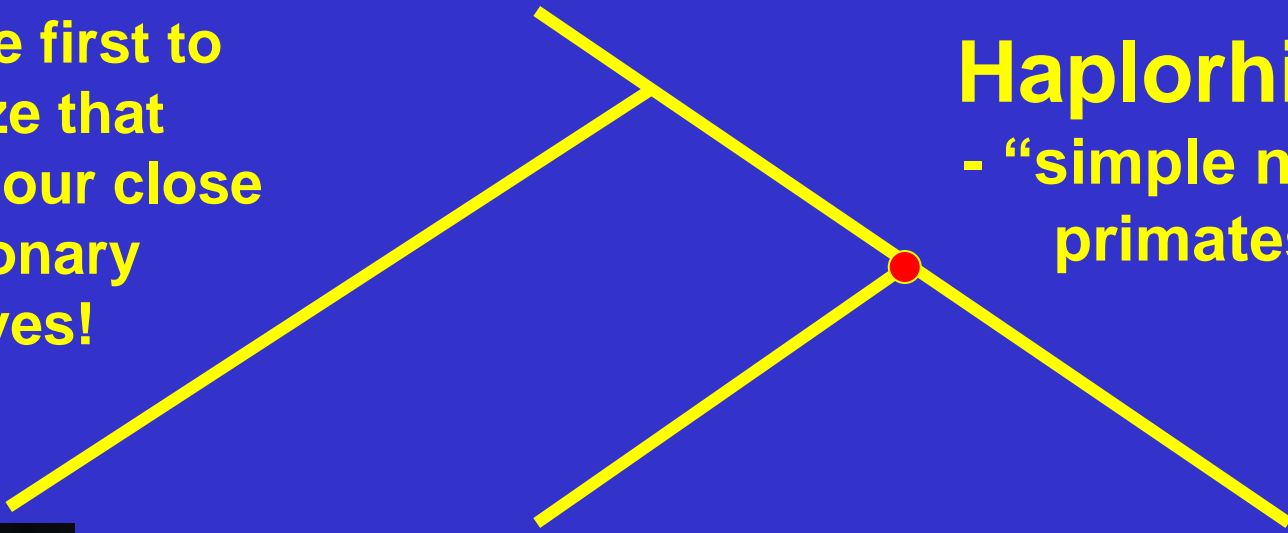


monkey



Pocock the first to recognize that tarsiers are our close evolutionary relatives!

**Haplorhines**  
- “simple nosed primates”



**Tarsiers**



**Monkeys,  
Apes, &  
Humans**

**Lemurs & Lorises**



**You might be thinking:**



**“Why is this guy who studies fossil primates so into tarsiers?”**





**The fossil record  
of definitive  
tarsiers starts  
during the  
Eocene epoch  
(56-34 million  
years ago)**

**Shanghuang,  
China,  
45 million years  
old**

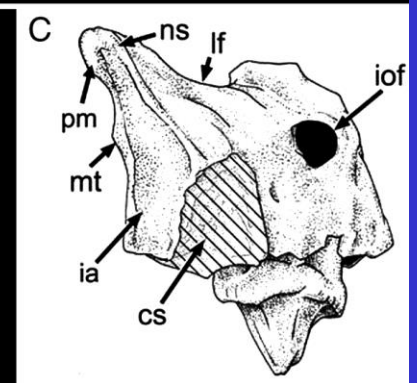
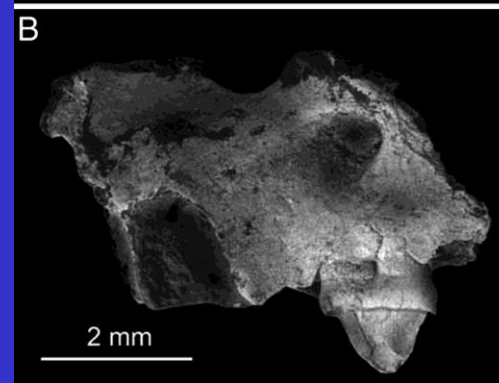
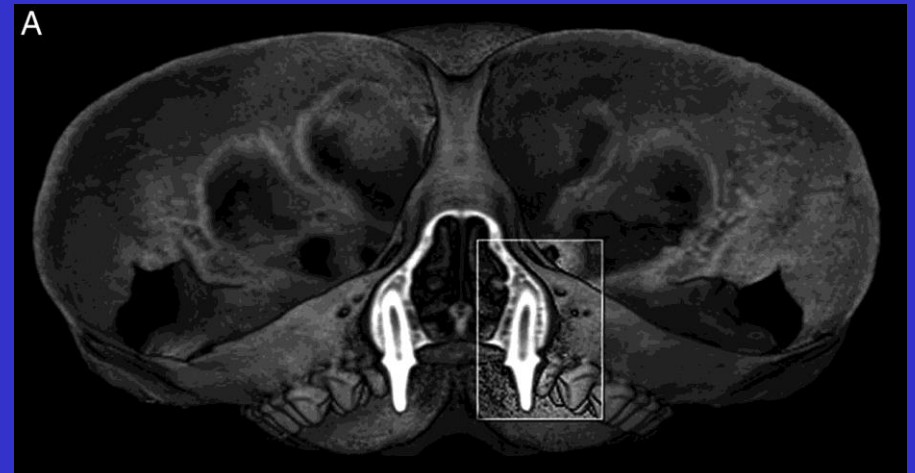
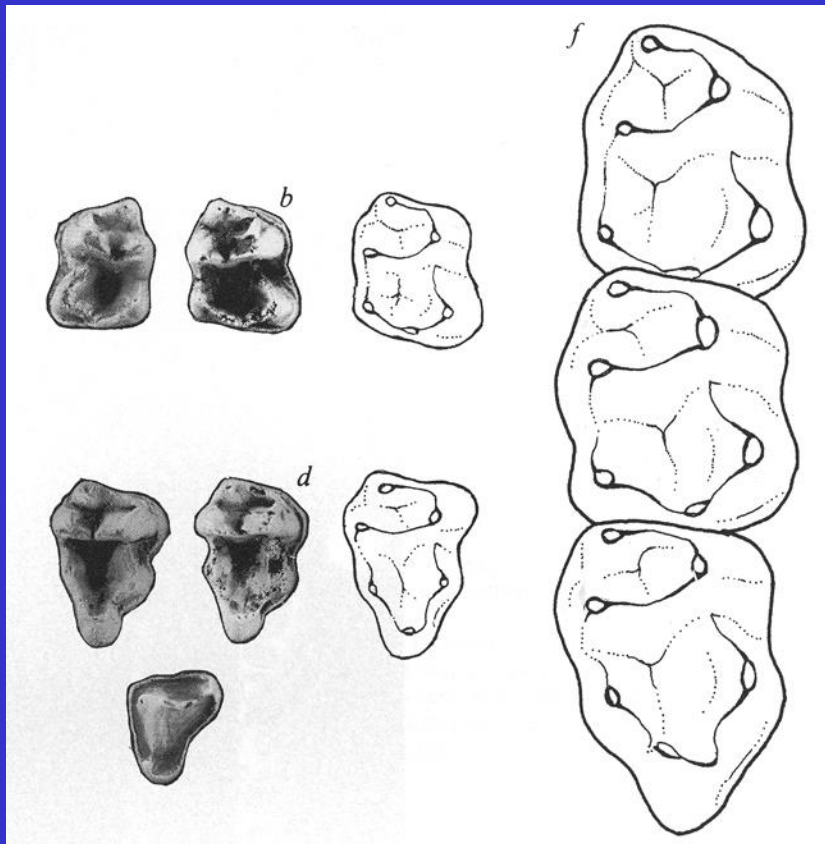




**Filled with fossils  
of small mammals  
eaten by ancient  
owls...**



# Includes teeth and cranial fragments of a tiny Eocene tarsier: *Tarsius eocaenus*





**Our genus (*Homo*)  
has existed for < 3  
million years**



**(Class of '92)**

**Tarsiers have been  
around for at least  
45 million years!**



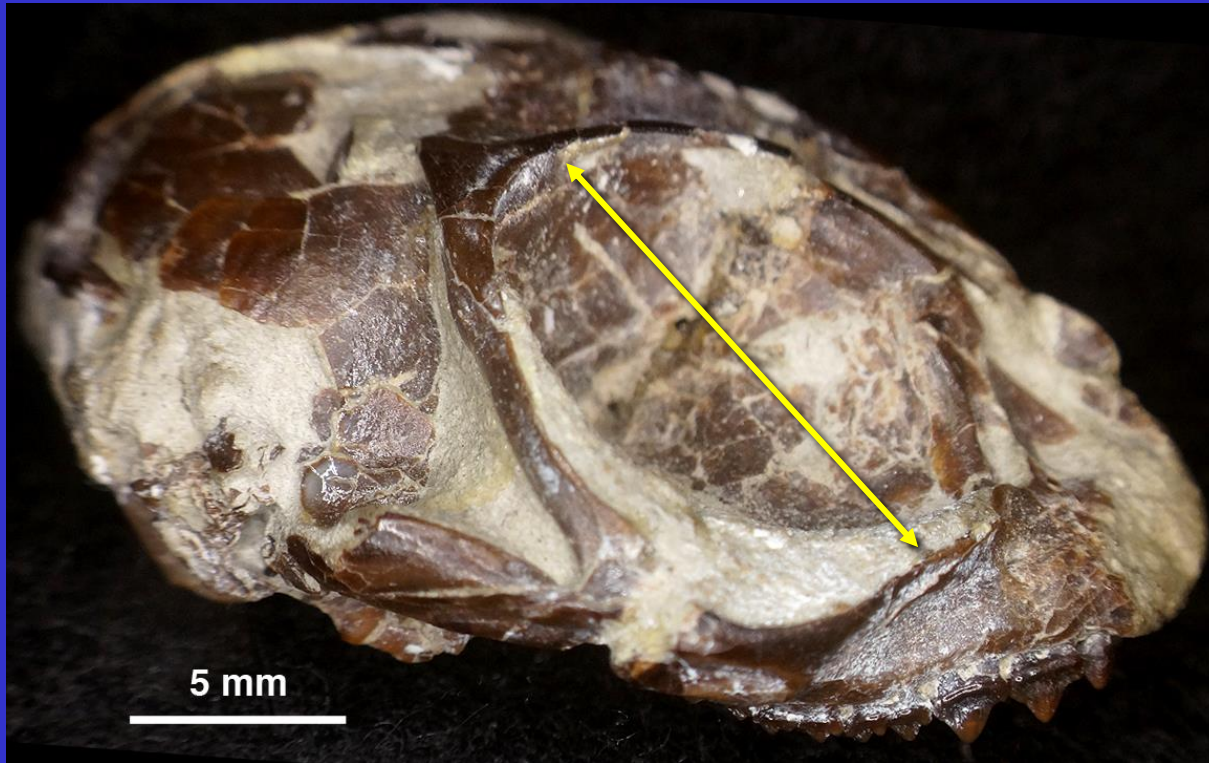


Most of my fossil research is in North America  
Interesting group of Eocene primates: Omomyoids





**An omomyoid primate - *Shoshonius***  
**51 million years old, Wyoming**



- Small (115 grams)
- Huge Eye Sockets
- Diet: Insects & fruit

**An omomyoid primate - *Shoshonius*  
51 Million Years Old, Wyoming**



**- An early  
tarsier relative?**

**But: Didn't  
have huge  
hands and feet**



**There are also omomyoids from the Eocene  
of Texas...**





*Rooneyia  
viejaensis*

~ 38 million  
years old

UT Prof. John  
A. Wilson,  
1966





I've been collecting omomyoids in the Big Bend since 2004



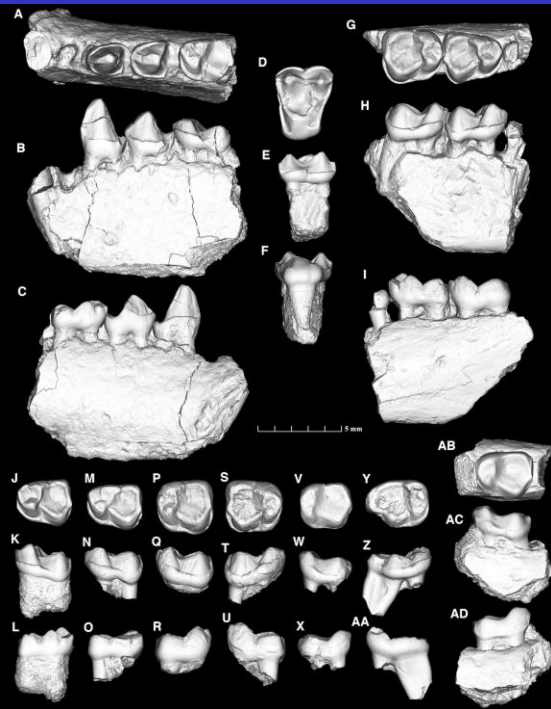


**The Big Bend was a different place in the Eocene...**

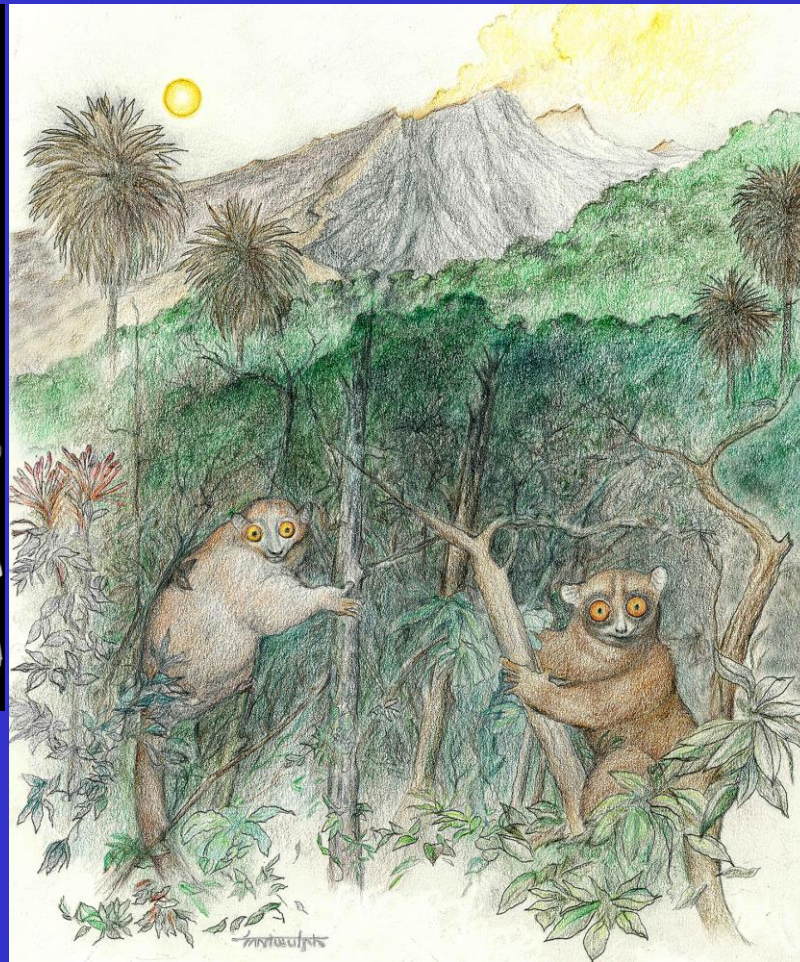




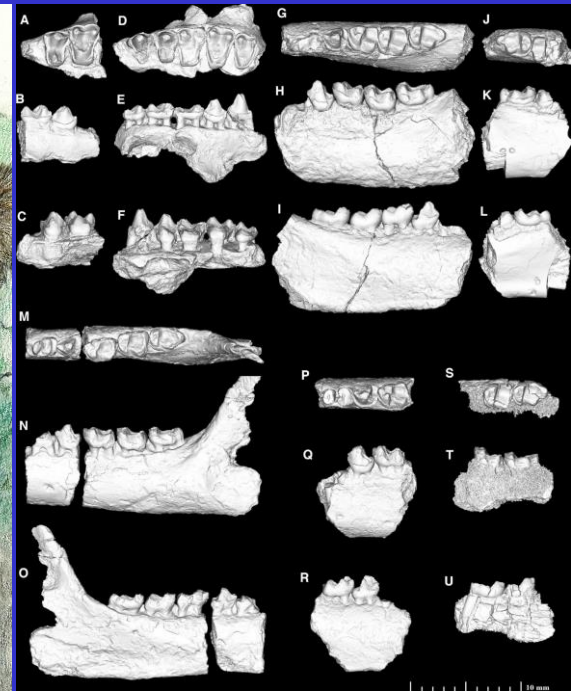
# Many species of Big Bend omomyoids!



*Mytonius  
williamsae*  
(2023)



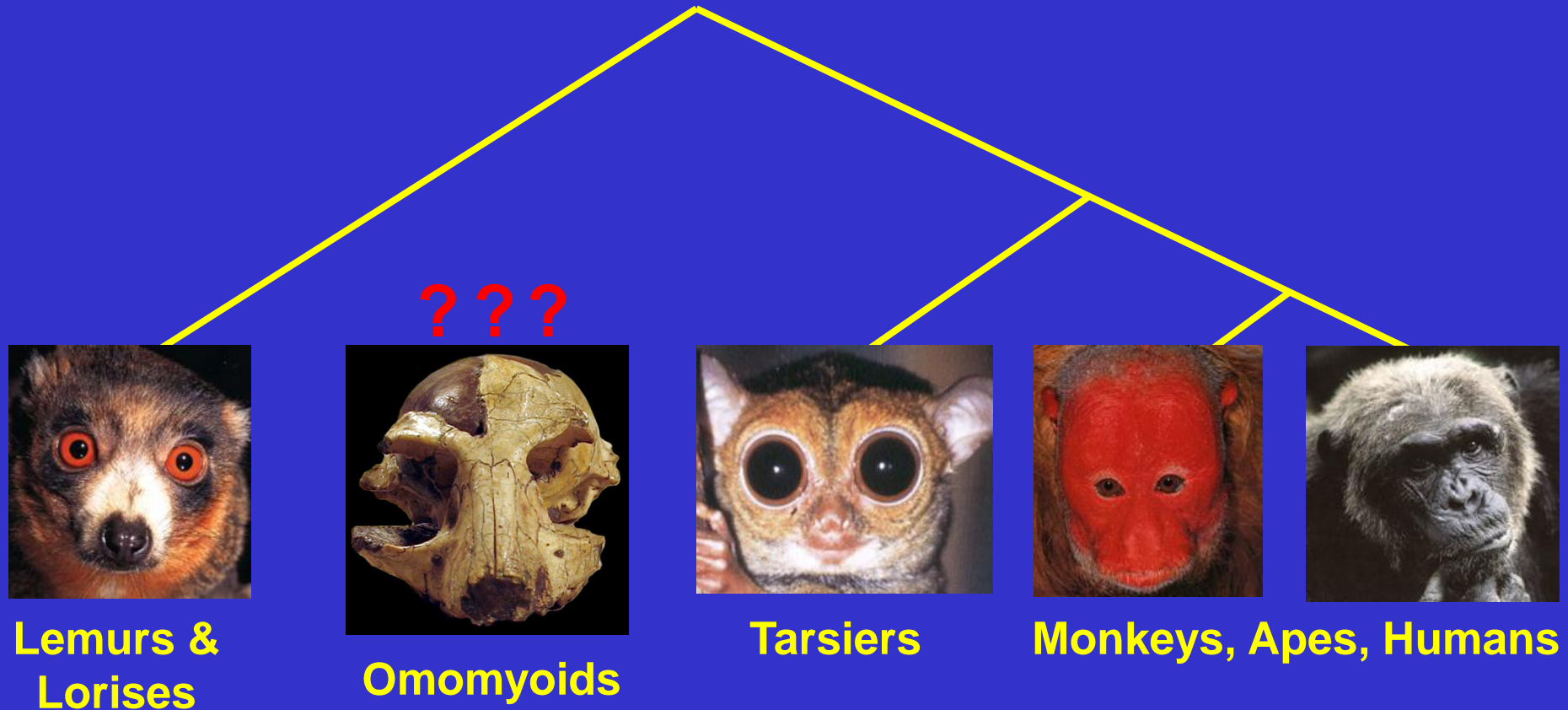
44 million years ago



*Diablomomys  
dalquesti*  
(2008)

# One BIG QUESTION for me:

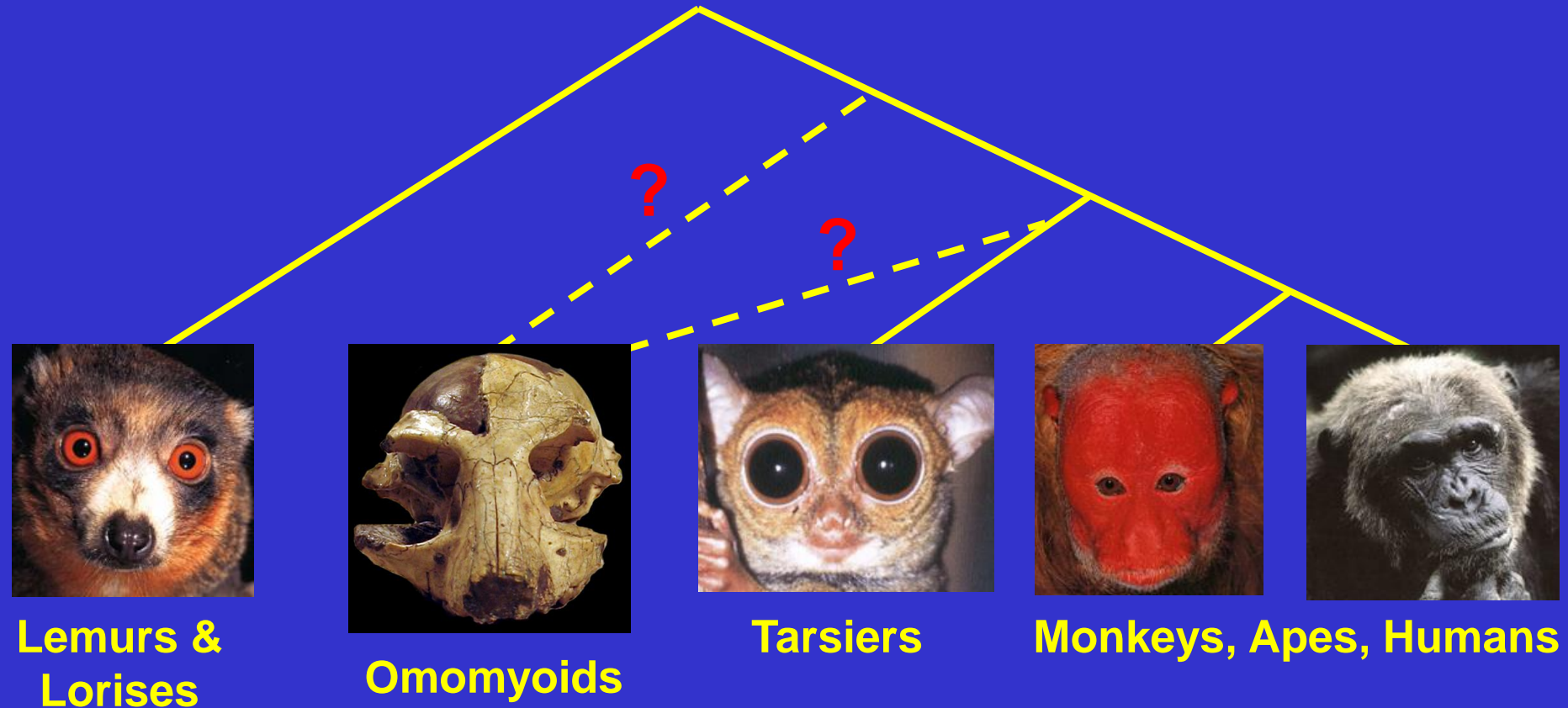
## How are omomyoids related to living primates?



Remember: This diagram is like a “family tree” for primates, but it shows their *evolutionary* relationships...

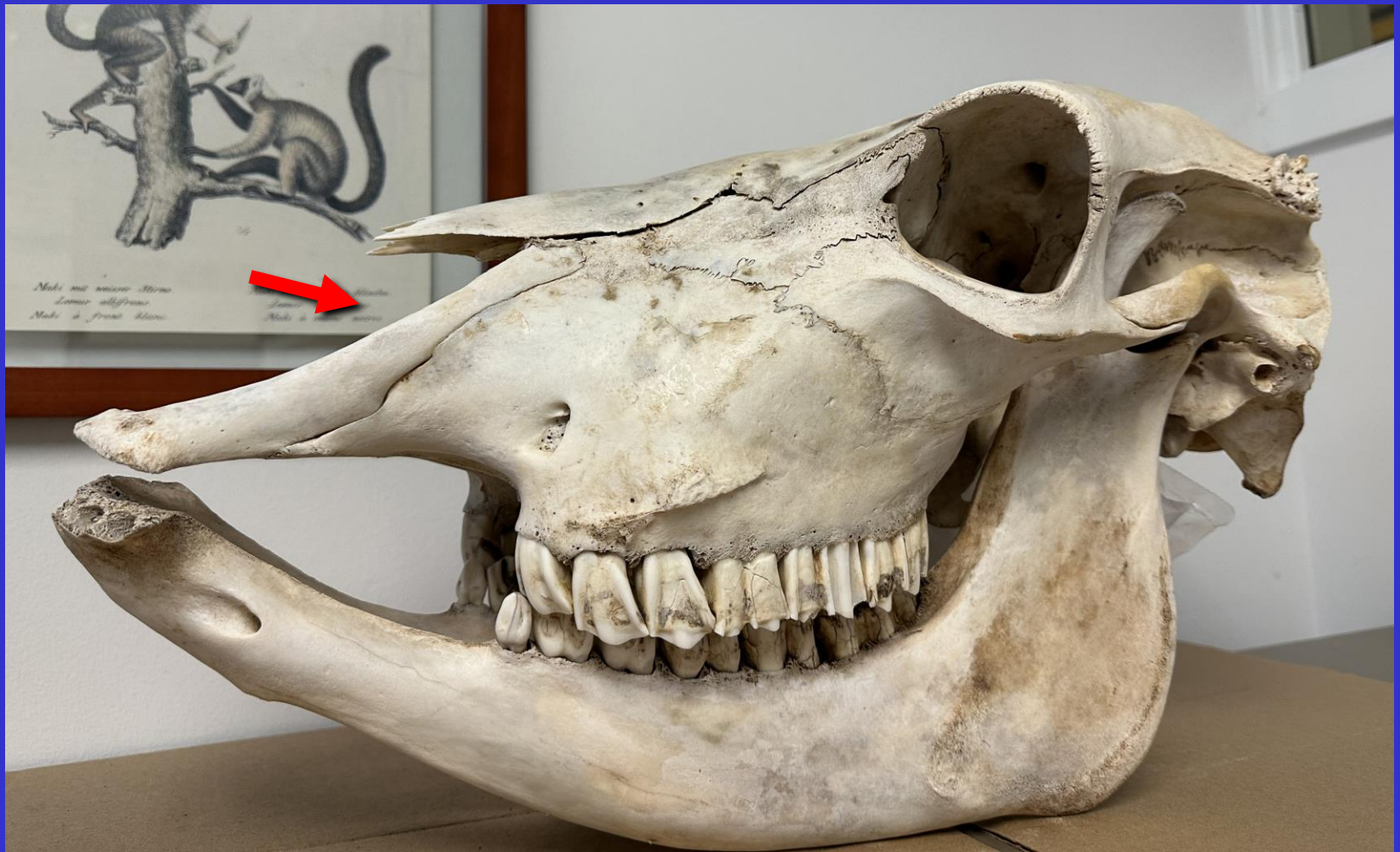


# Two main hypotheses for omomyoids: (1) Primitive tarsiers or (2) Early haplorhines

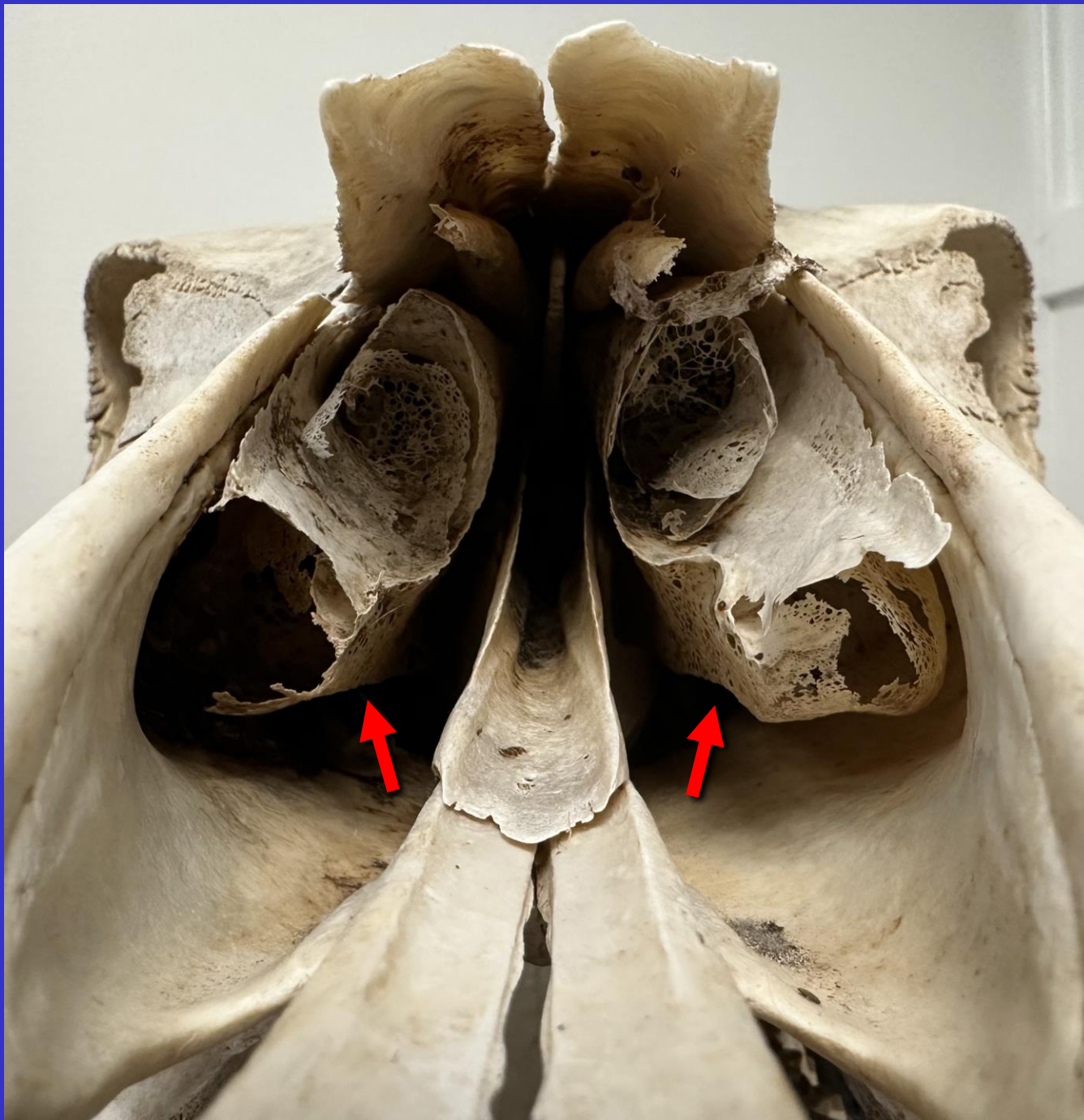


**Let's consider the evidence:**

**Q: Have you ever looked in the nose of a cow skull?**







- Paper-thin scrolls of bone: Turbinals

- Covered with mucus membrane

- Some used for air conditioning (“respiratory turbinals”)

- Some used for *smelling* (“olfactory turbinals”)

# The BEST way to study turbinals: 3D X-Ray scanning (micro CT)

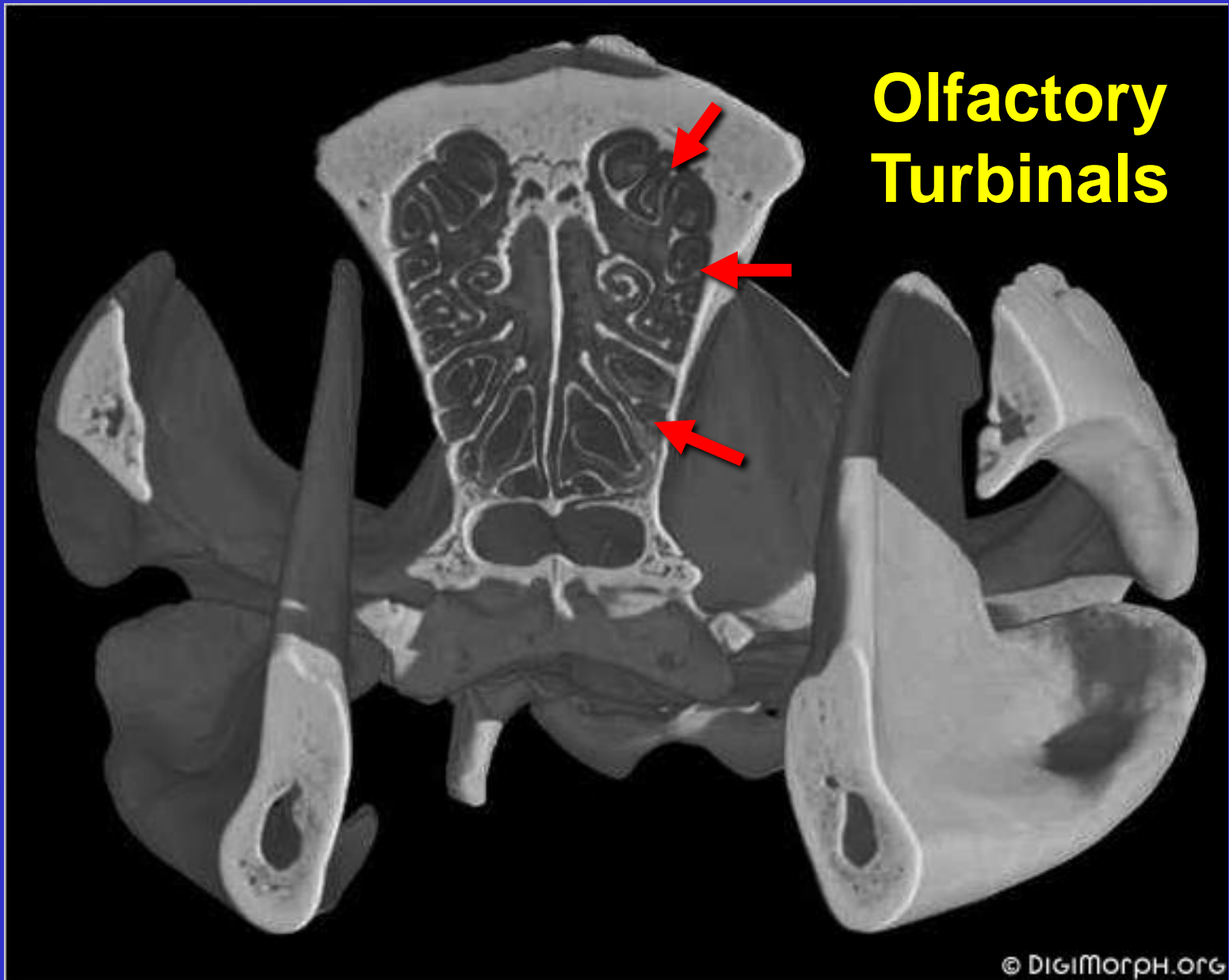


**UT happens to have the premiere micro CT  
scanning facility in the world!**





**Opossum: Typical Mammal**



**Olfactory  
Turbinals**

**Opossum: Typical Mammal**





Things that are smelly are shedding chemicals into the air...



In order to smell them, you have to draw those chemicals into your nasal cavity where they can bind with a specialized mucous membrane



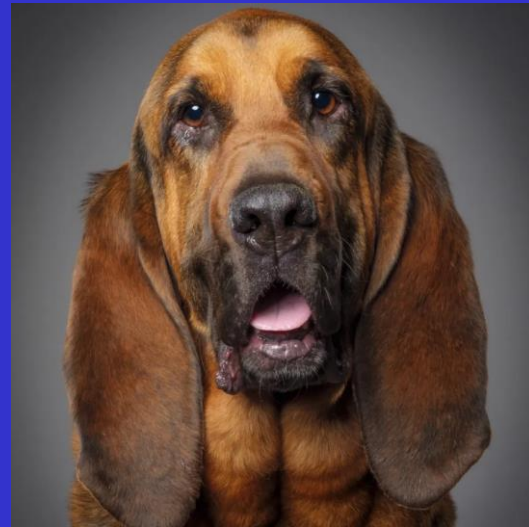
The general rule:

More olfactory turbinals  
=  
More surface area for smelling stuff  
=  
Better sense of smell

(Class of '91)



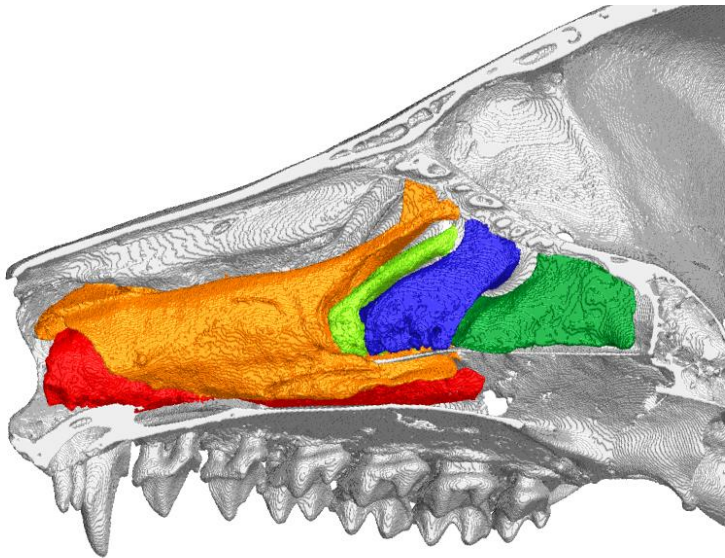
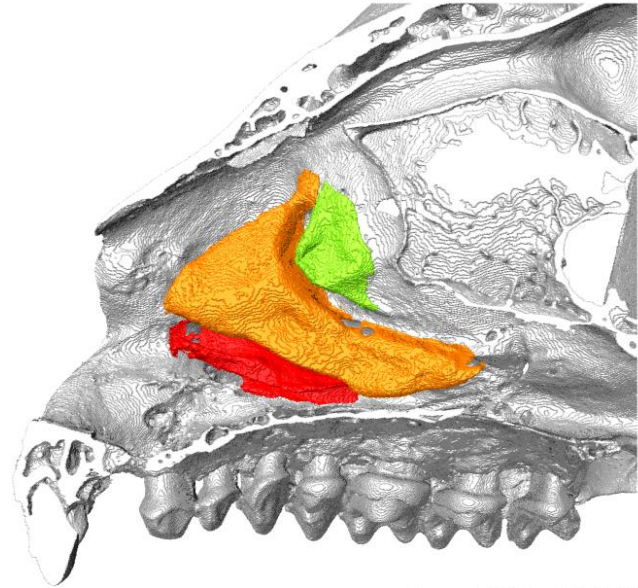
Human: 10 cm<sup>2</sup>  
- 2 olfactory turbinals



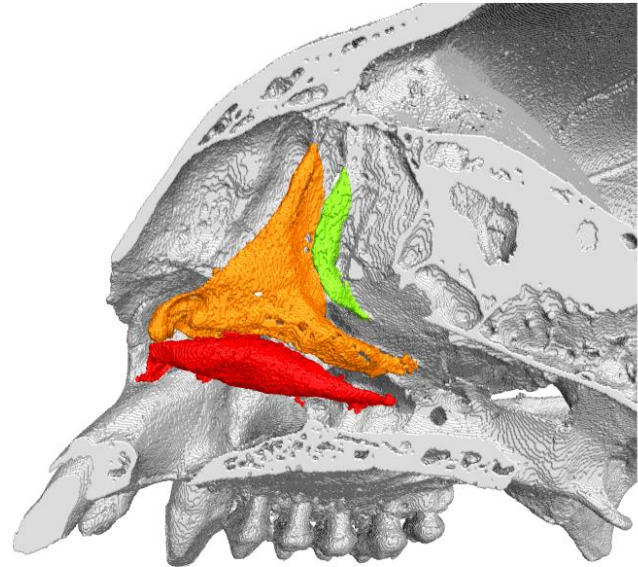
Dog: 160 cm<sup>2</sup>  
- 12-16 olfactory turbinals

**Micro CT images  
of primate  
turbinals in the  
nasal cavity**

**Tarsier**



**Lemur**

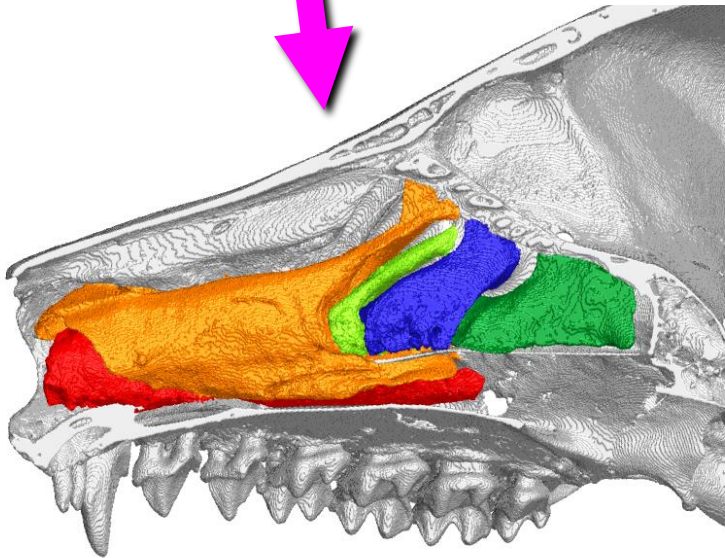
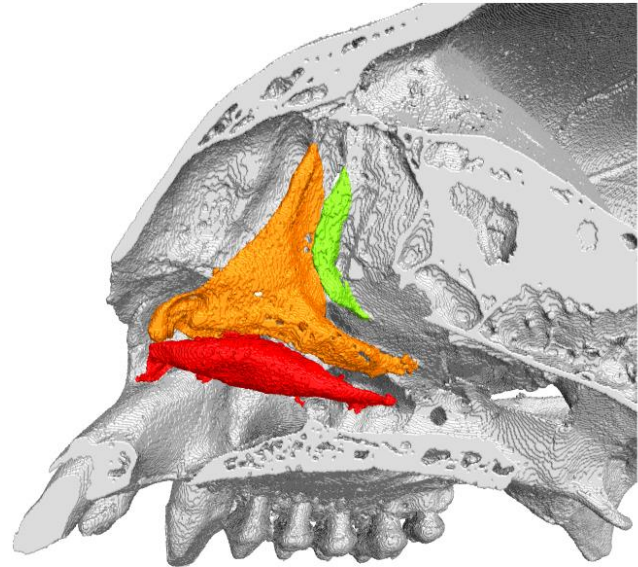
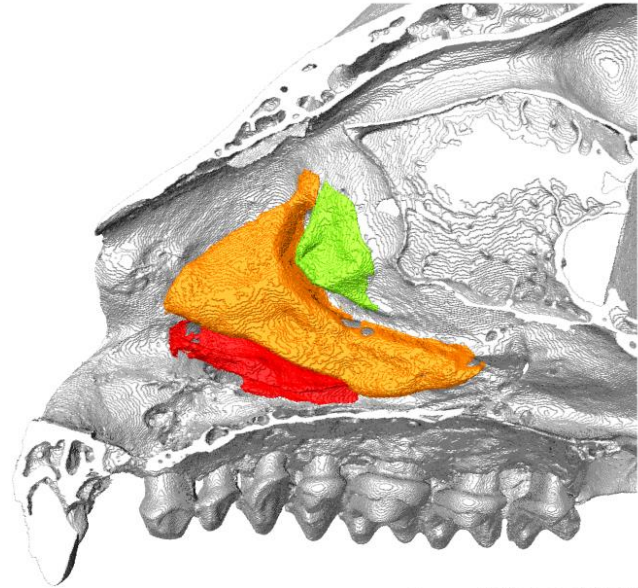


**Monkey**



# Tarsier

**Lemur:**  
**Typical Mammal**  
**- Lots of olfactory**  
**turbinals (7-8)**

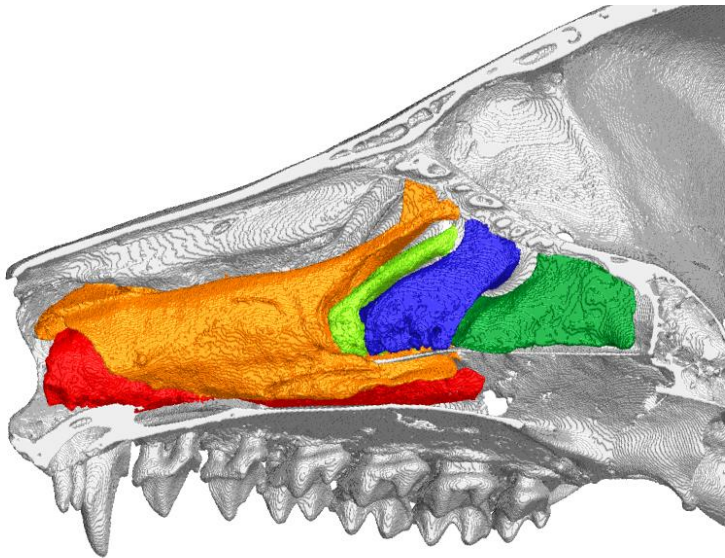
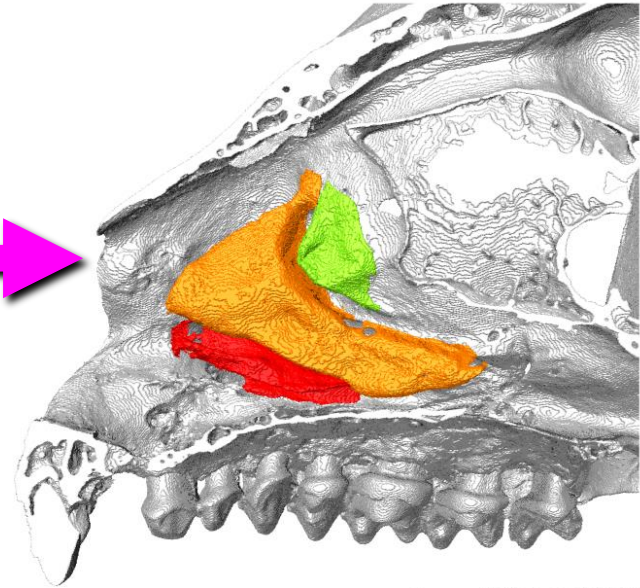


**Lemur**

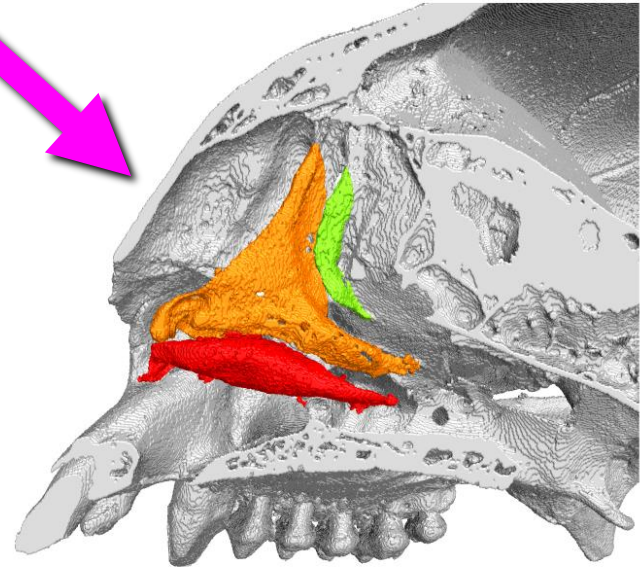
**Monkey**

**Tarsier**

**Haplorhines:  
Very Unusual  
- Only *two*  
olfactory turbinals**



**Lemur**



**Monkey**

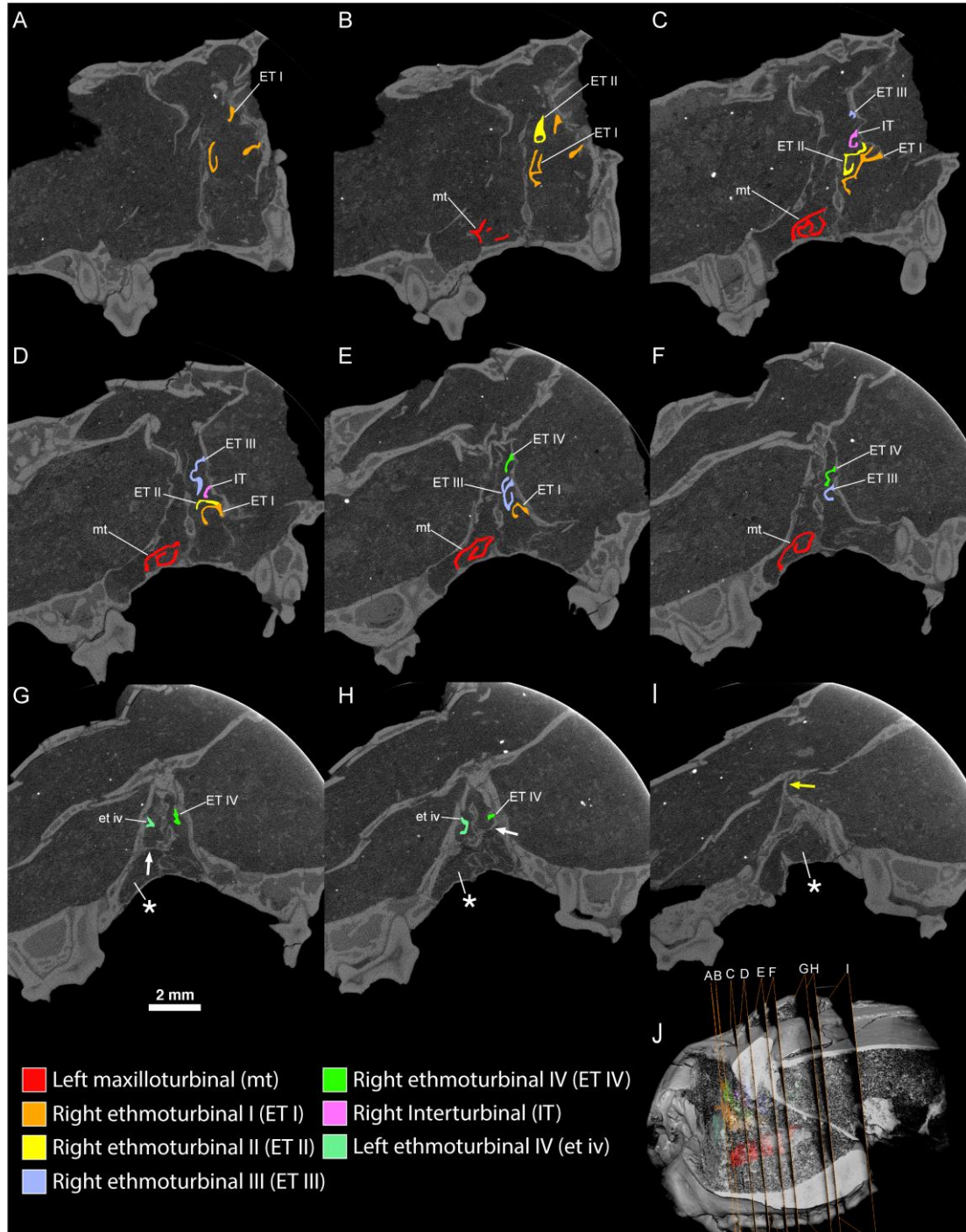


Dr. Ingrid Lundeen



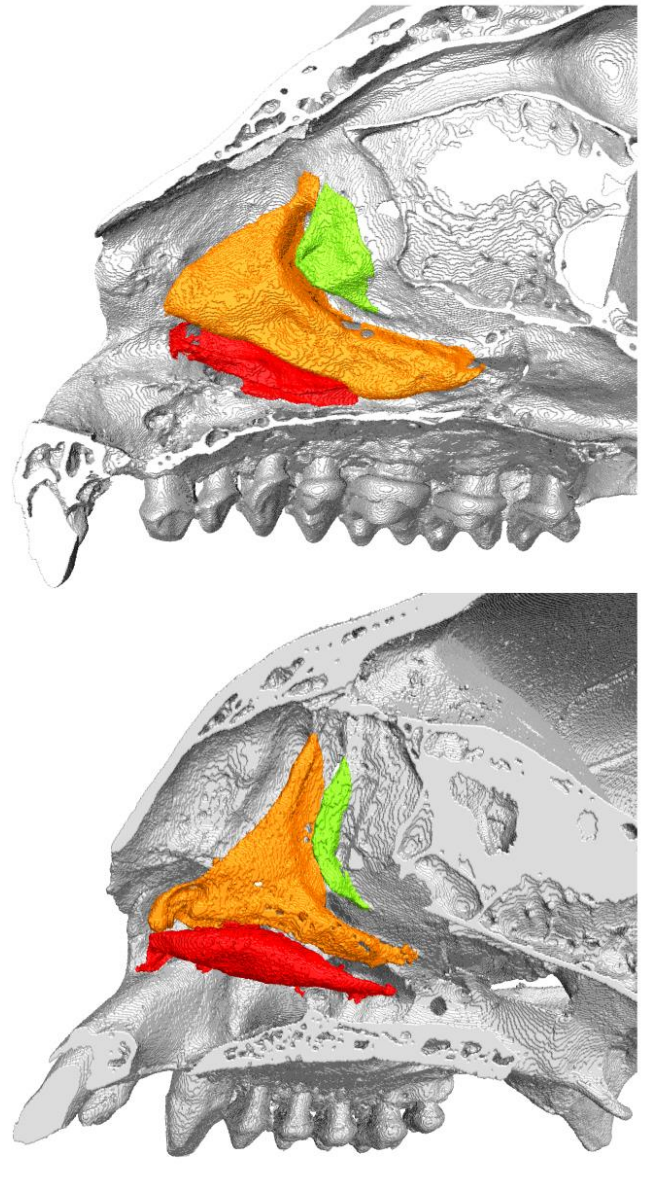
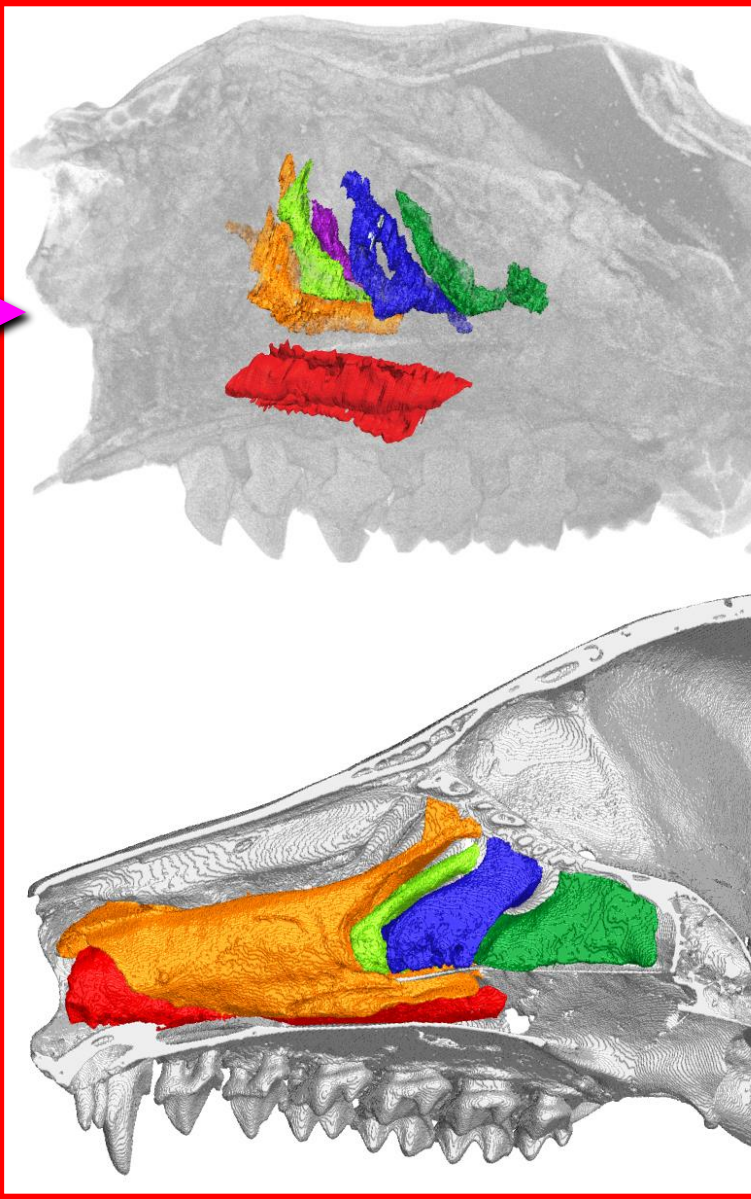
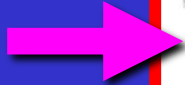
Micro CT scans  
from UTCT:

Turbinals of  
*Shoshonius*



**Shoshonius: 6 + turbinals**

**Tarsier**



**Lemur**

**Monkey**





**More evidence:  
tarsiers, monkeys,  
apes, & humans have  
a visual superpower  
that all other  
mammals lack...**



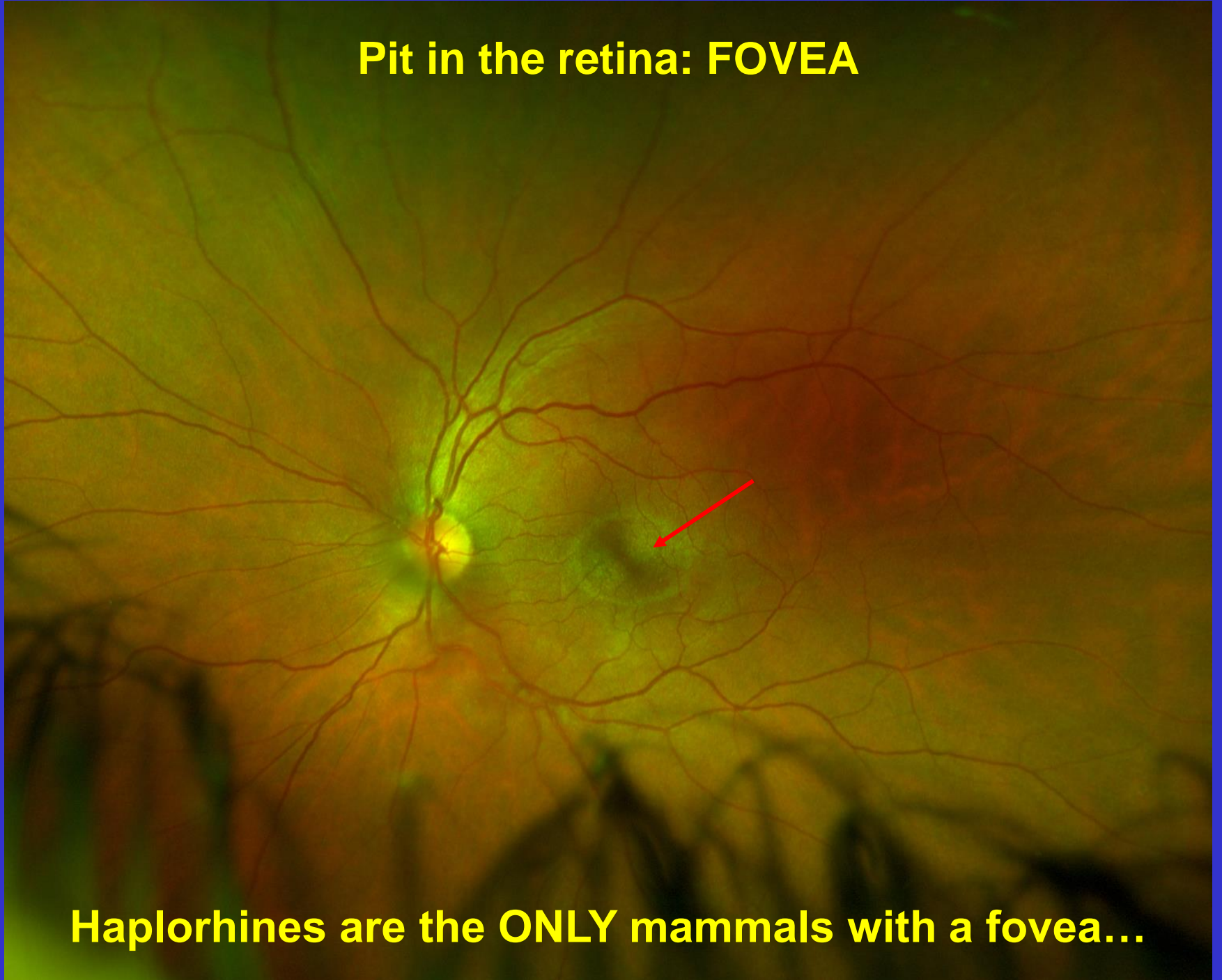
**Here's a view of the Retina in the back of my eye**



**I am a Haplorhine!**

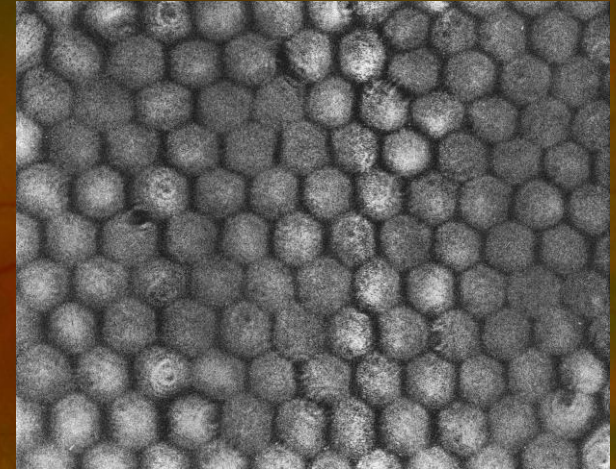


## Pit in the retina: FOVEA



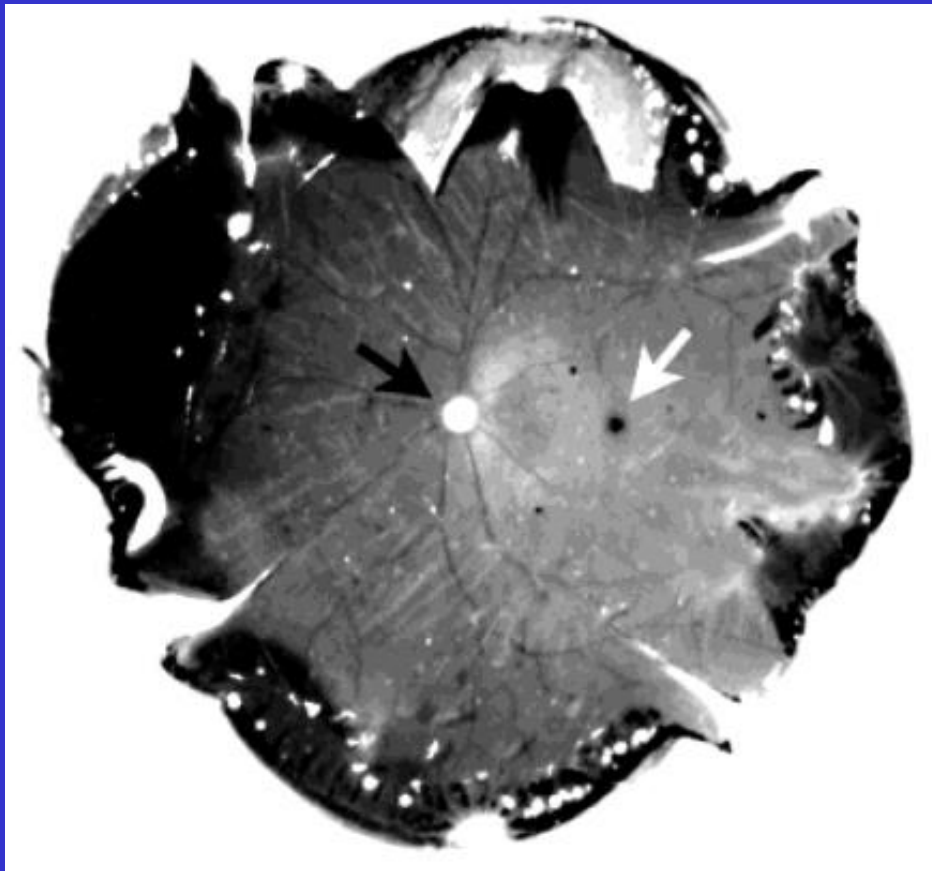
Haplorhines are the **ONLY** mammals with a fovea...

**Inside the fovea: A dense concentration of visual cells called cones**



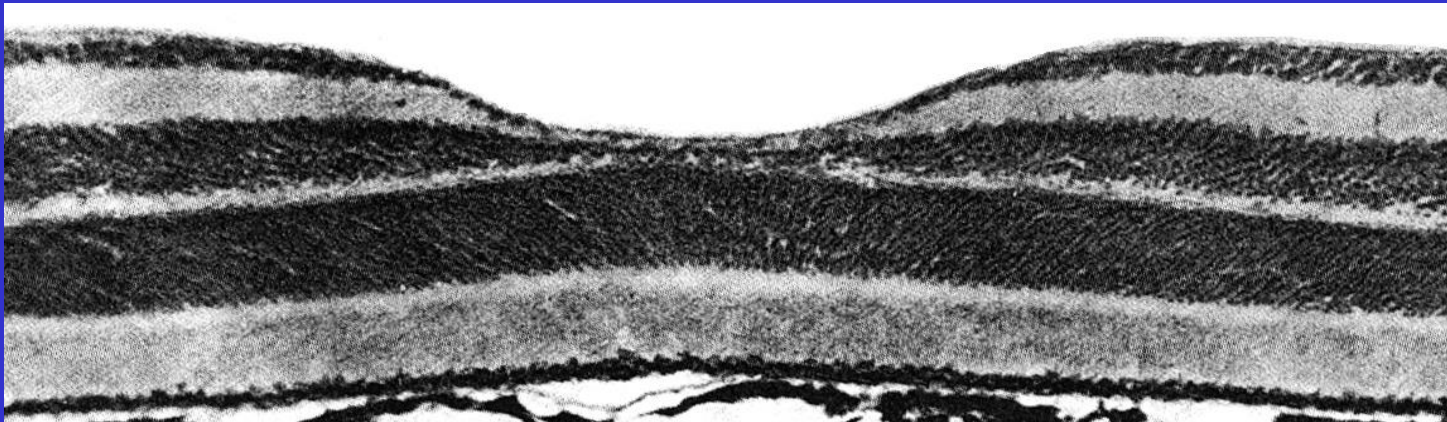
**Gives us exceptional vision for details...**  
**- Very high visual acuity**





**Tarsiers are  
*extremely* weird:**

- Nocturnal, but have a fovea
- Fovea also contains high density of cone cells



As a result, tarsiers have *weirdly* high visual acuity for a nocturnal mammal...



eye 1.8 cm diameter



Figure 9.2. A Snellen chart.



eye 4 cm diameter  
(~ ping pong ball)



Hold on a tic – you can't measure visual acuity  
in a *fossil*, can you?

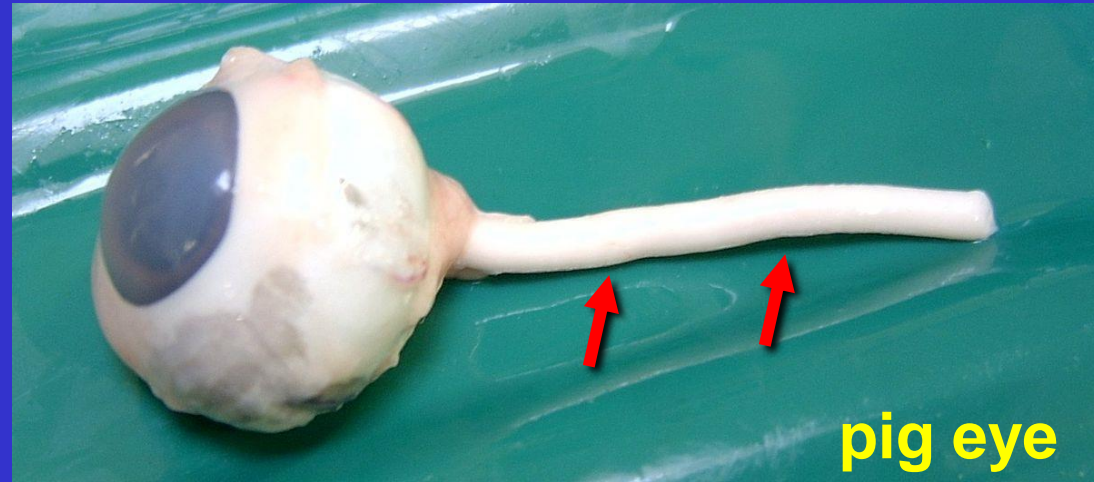


*Necrolemur* – an omomyoid

**Visual cells need to talk to the brain...**  
**- They do this via the optic nerve**



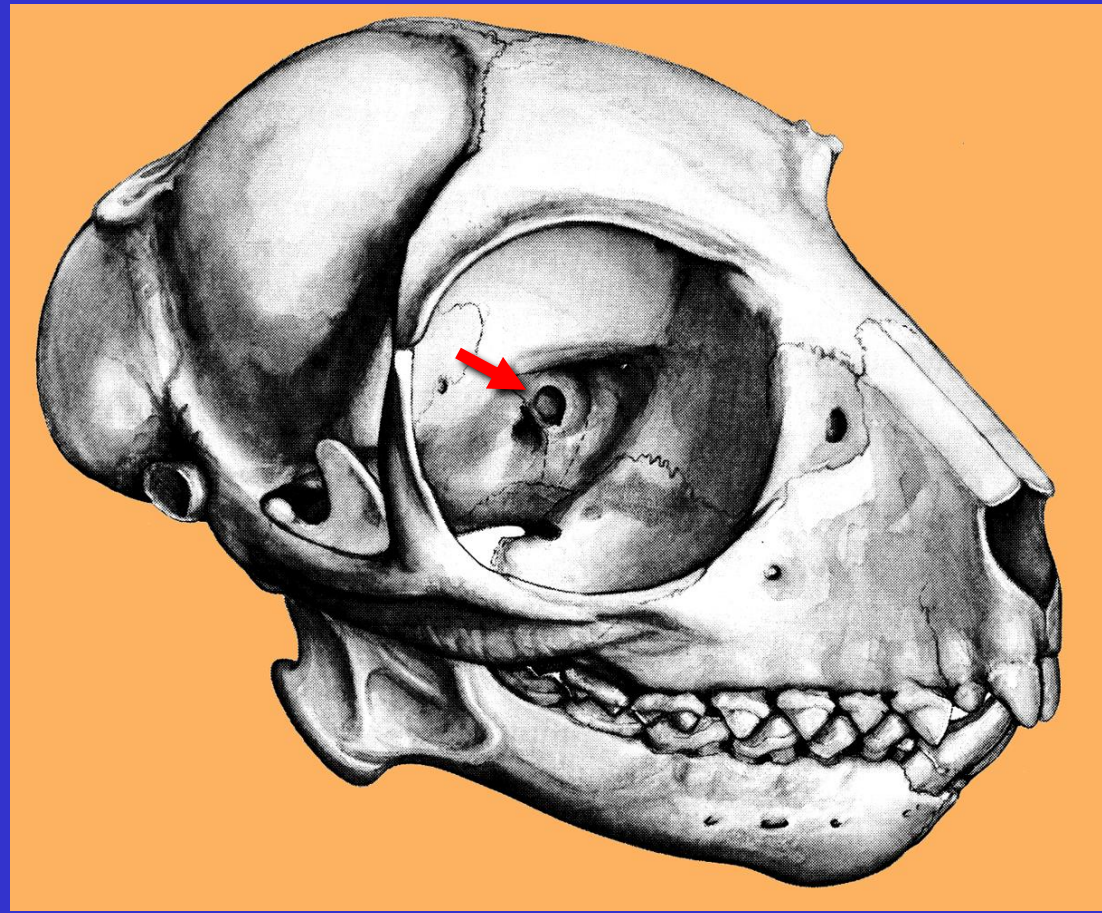
***Necrolemur – an omomyoid***



**Tarsiers and other  
haplorhines have a HUGE  
optic nerve...**



So: you can measure the size of the hole in the back of the eye socket (“optic foramen”) that the optic nerve passes through...

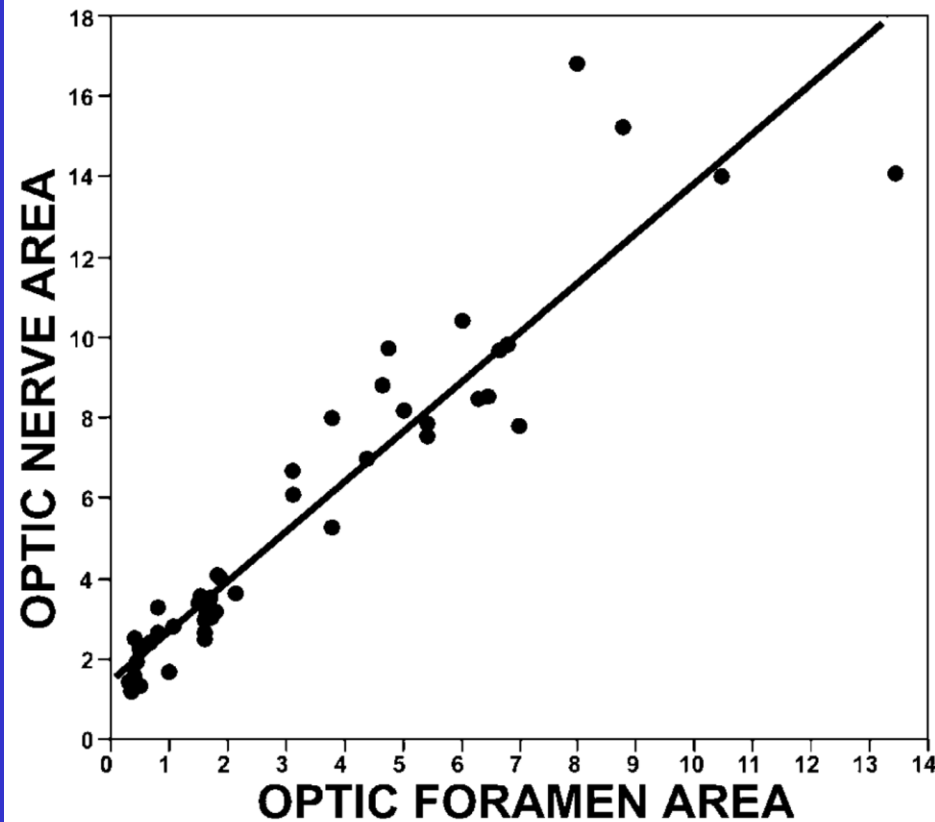


*Necrolemur* – an omomyoid

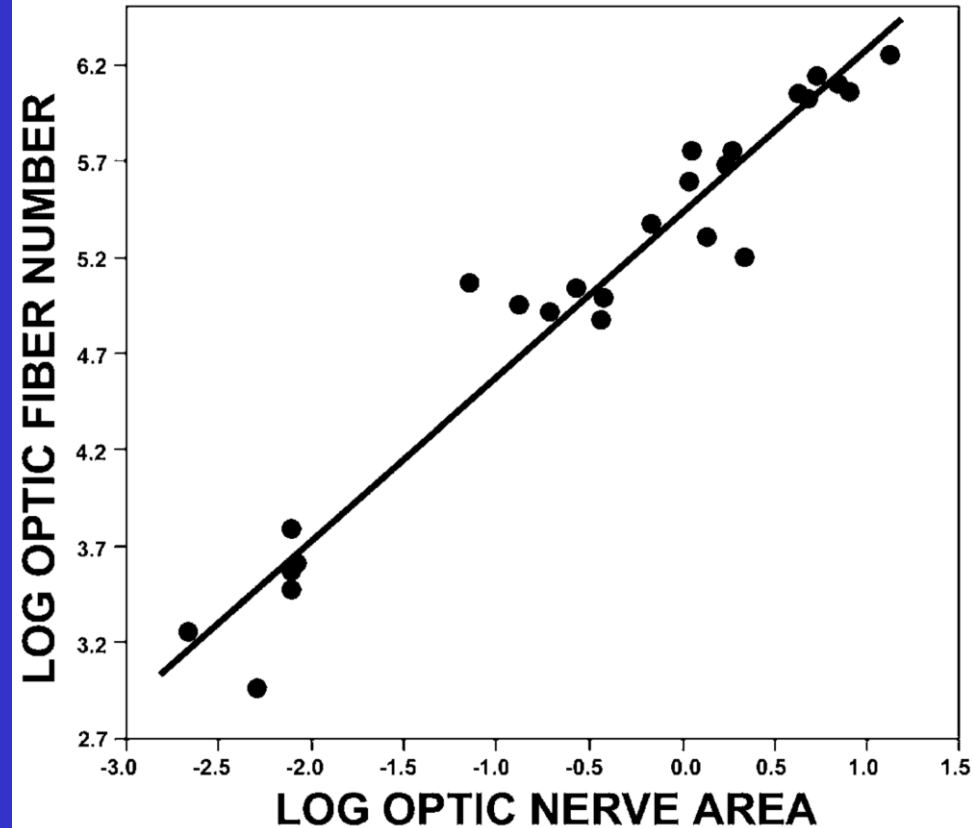
# First things first...

Primates with big optic nerves have bigger holes for those nerves

Mammals with big optic nerves are passing more information to the brain



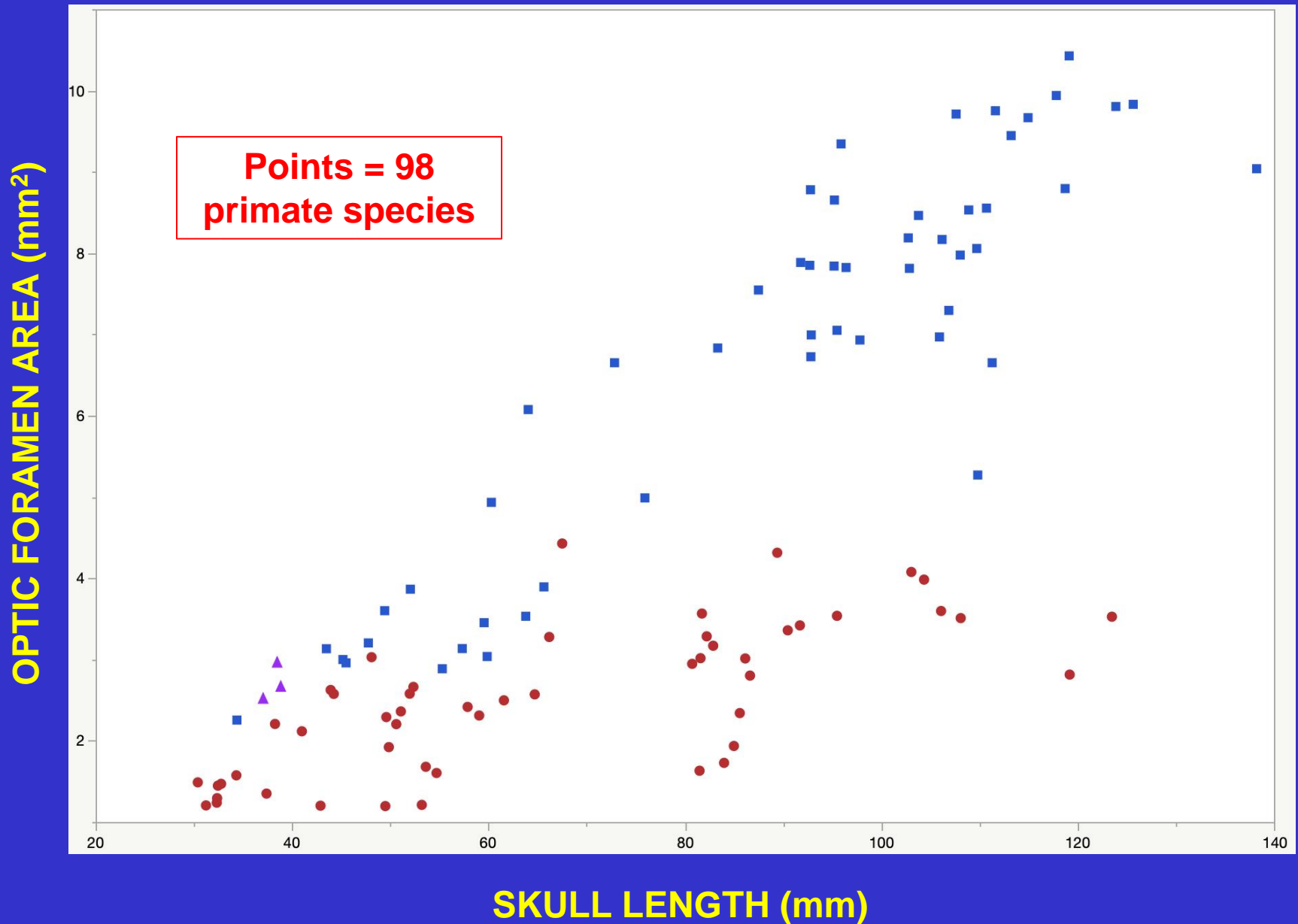
45 Primate Species



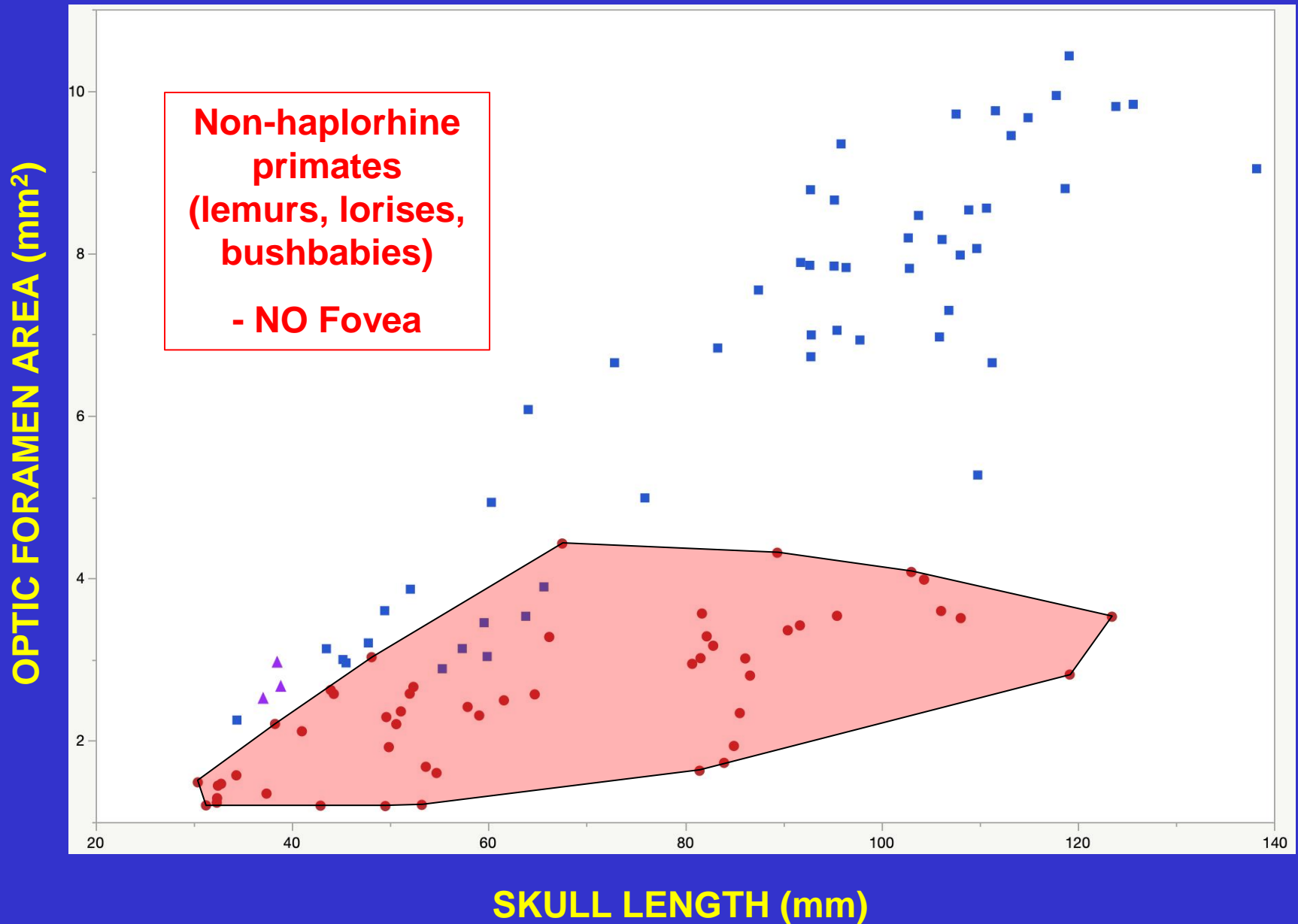
25 Mammal Species



# Relative optic foramen size

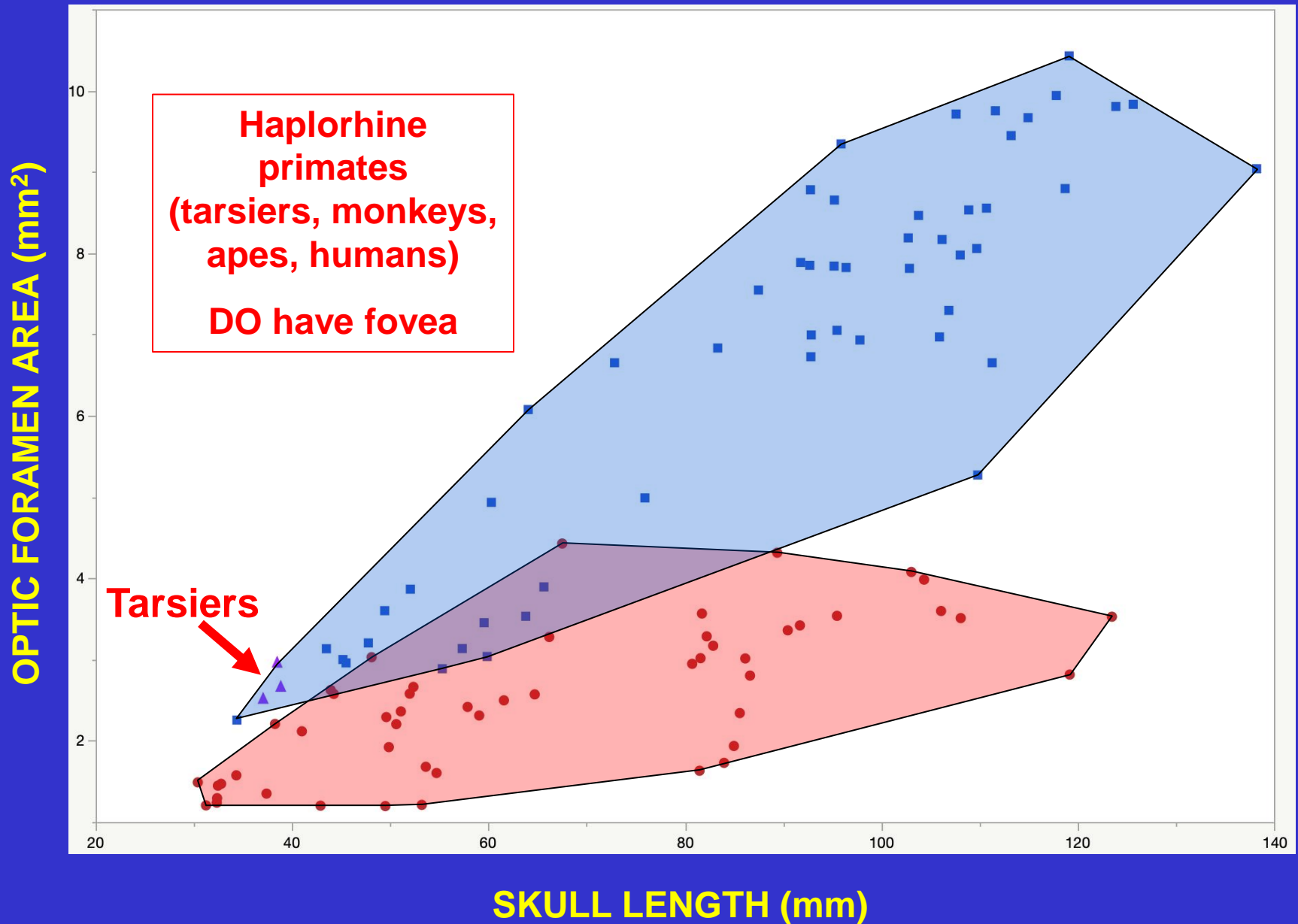


# Relative optic foramen size





# Relative optic foramen size



# Relative optic foramen size

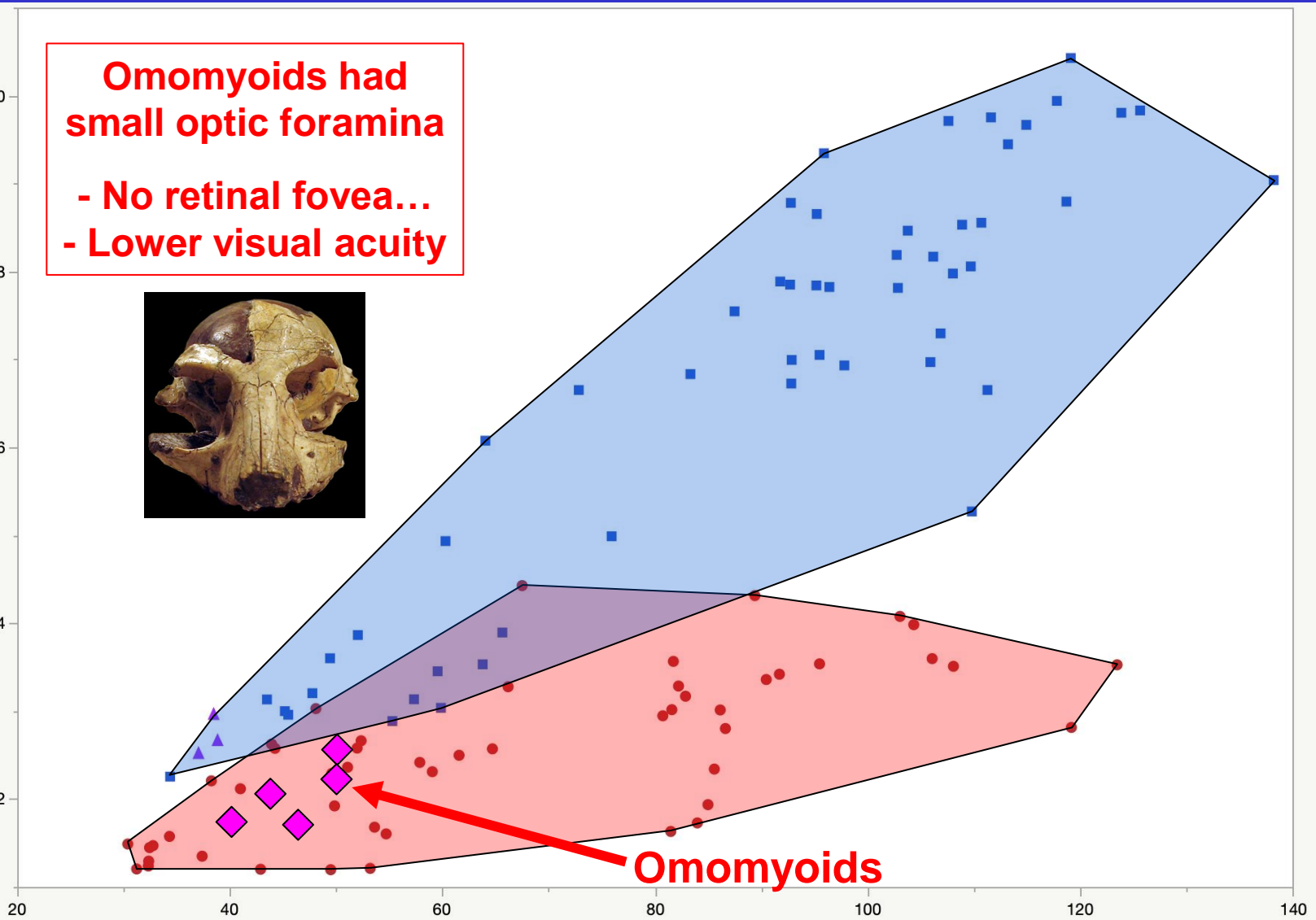
OPTIC FORAMEN AREA (mm<sup>2</sup>)

**Omomyoids had small optic foramina**

- No retinal fovea...
- Lower visual acuity



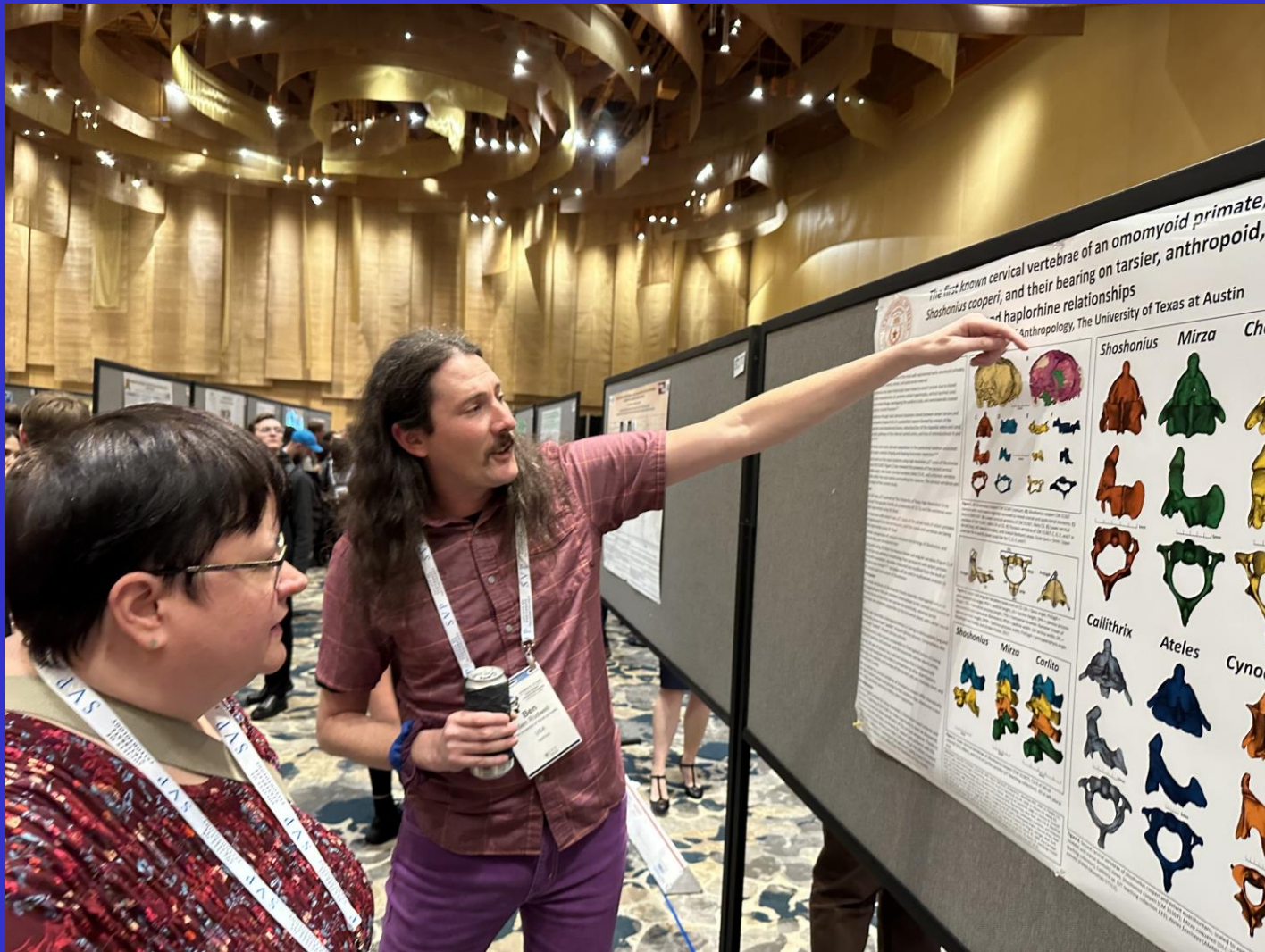
**Omomyoids**



SKULL LENGTH (mm)



# A final piece of evidence – work in progress, courtesy of Ben Rodwell



**Tarsiers have an amazing ability to rotate their heads – like an owl!**





**Tarsiers have an amazing ability to rotate their heads – like an owl!**



**Tarsiers have an amazing ability to rotate their heads – like an owl!**

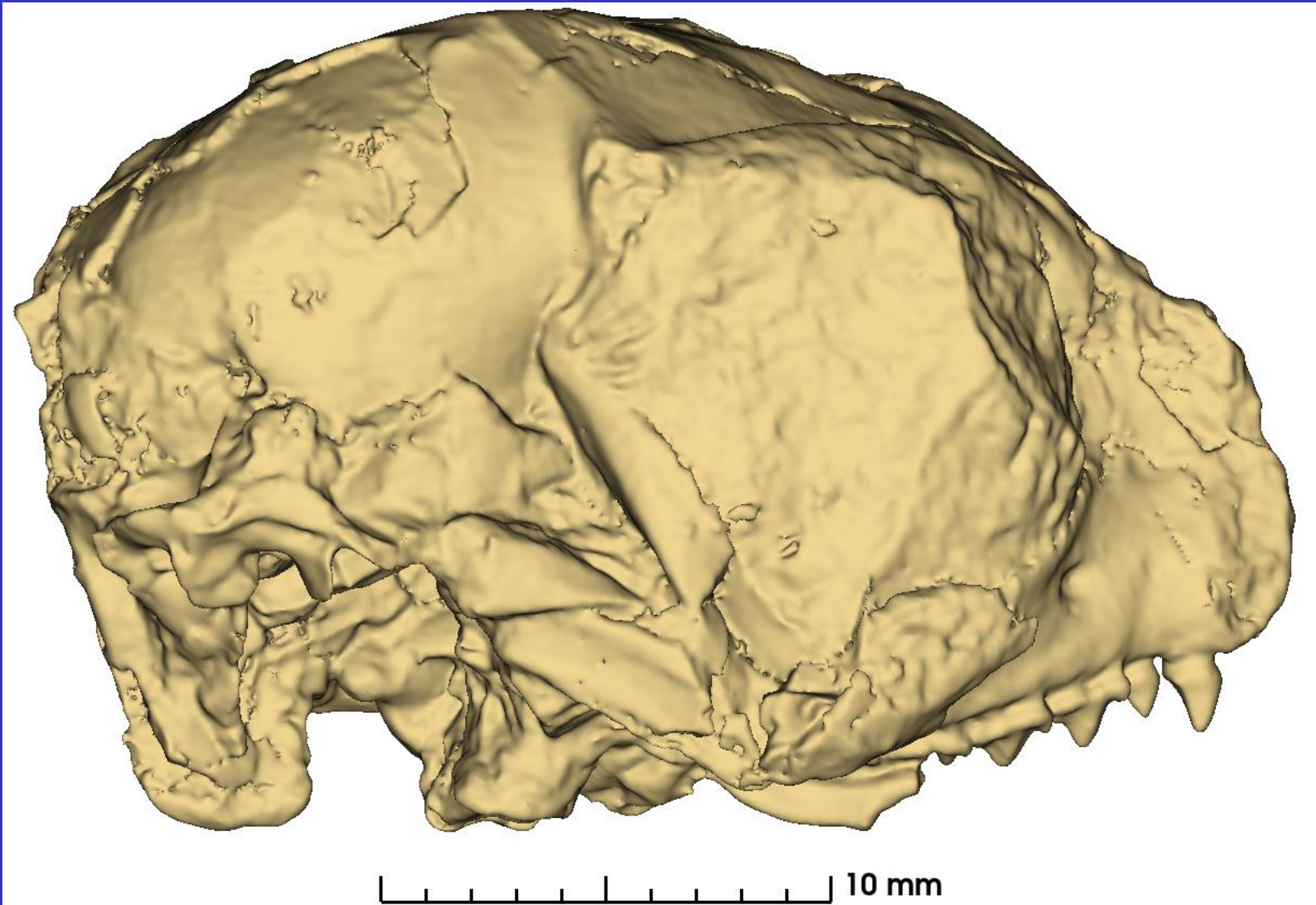




**Tarsiers have an amazing ability to rotate their heads – like an owl!**

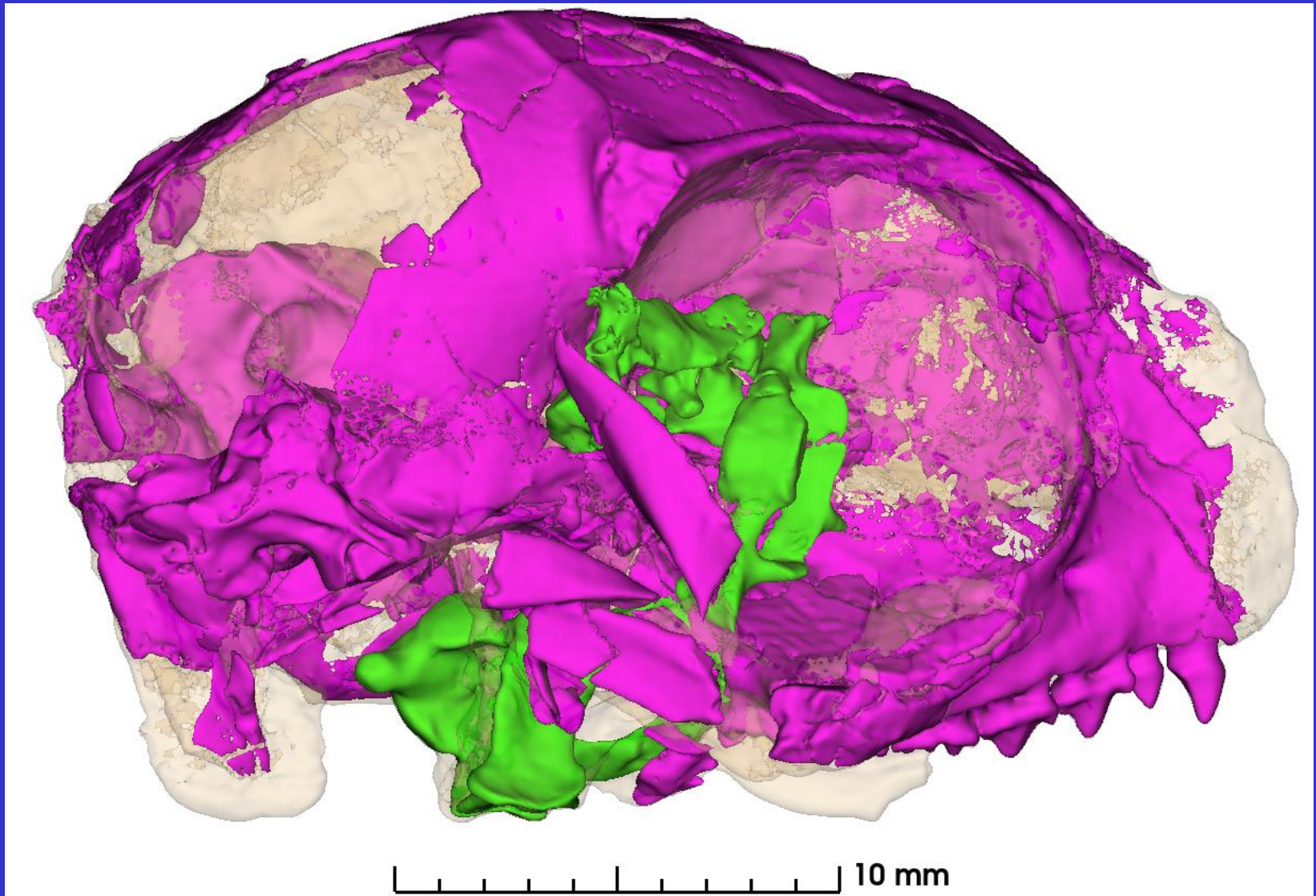


Those micro CT scans of *Shoshonius*  
had a surprise hiding in the “matrix”...

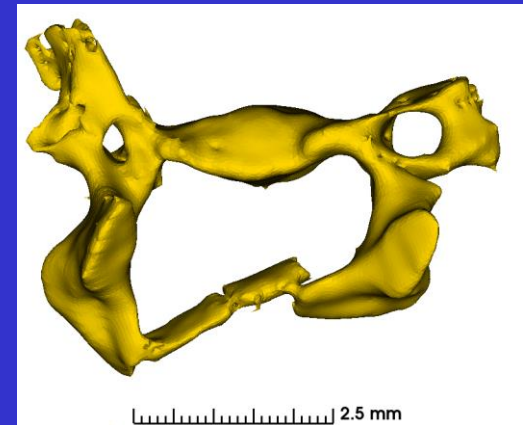
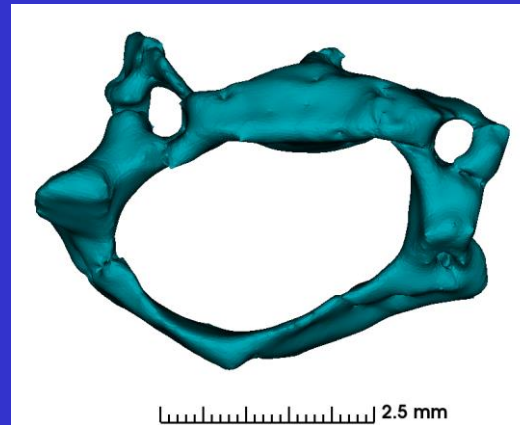
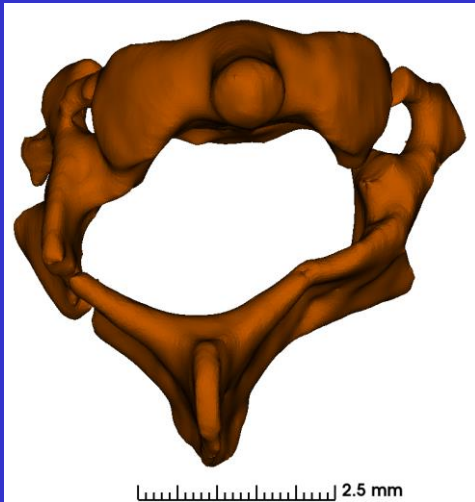




Those micro CT scans of *Shoshonius* had a surprise hiding in the “matrix”...

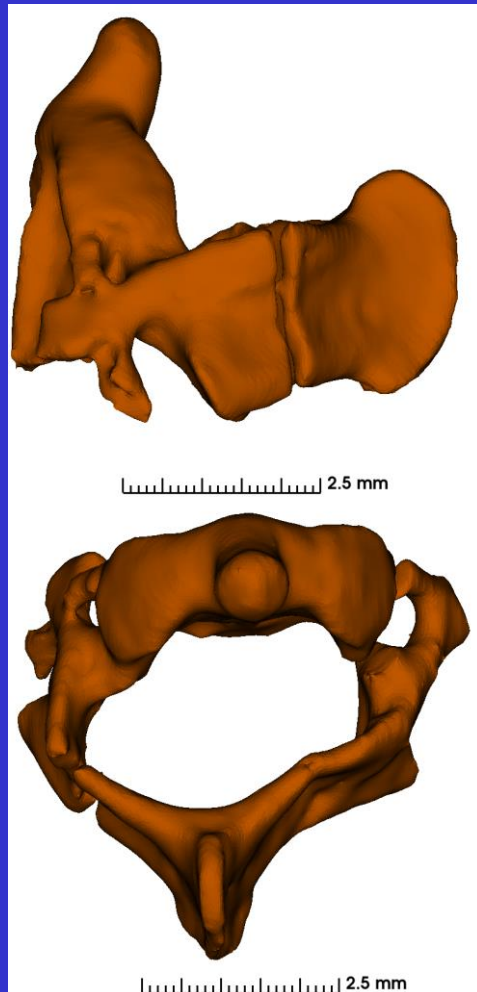


# The first omomyoid neck vertebrae ever discovered...



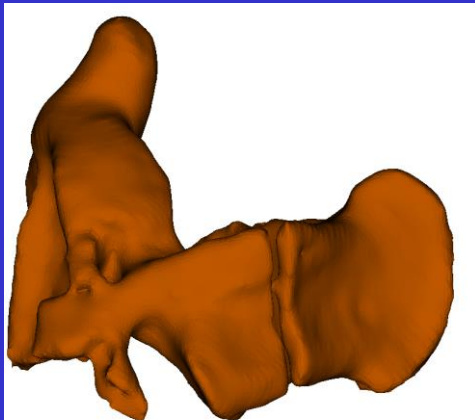


This is the axis (C2) of *Shoshonius* – one of the key neck vertebrae involved in head rotations

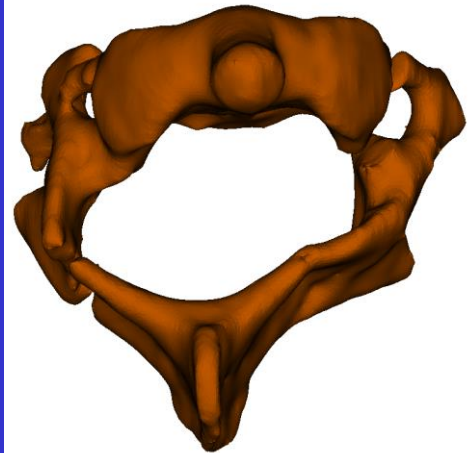


*Shoshonius*

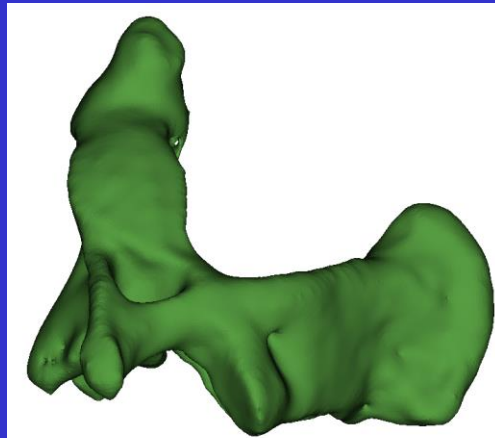
***Shoshonius* did NOT have ability to rotate its head like a tarsier...**



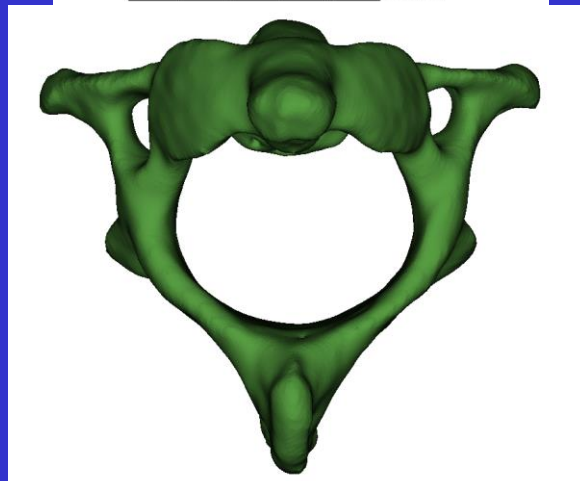
2.5 mm



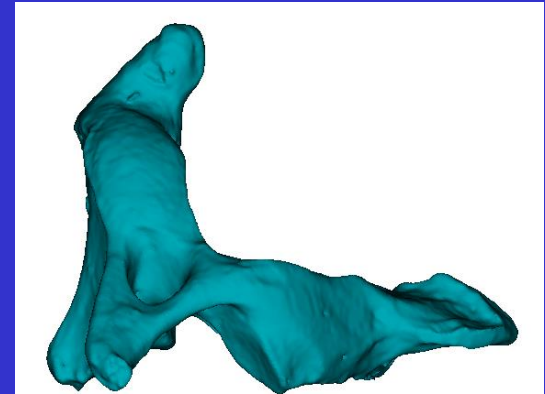
2.5 mm



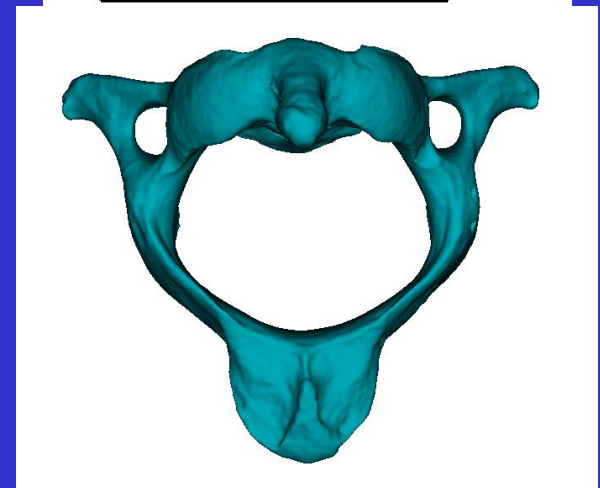
5 mm



5 mm



5 mm



5 mm

***Shoshonius***

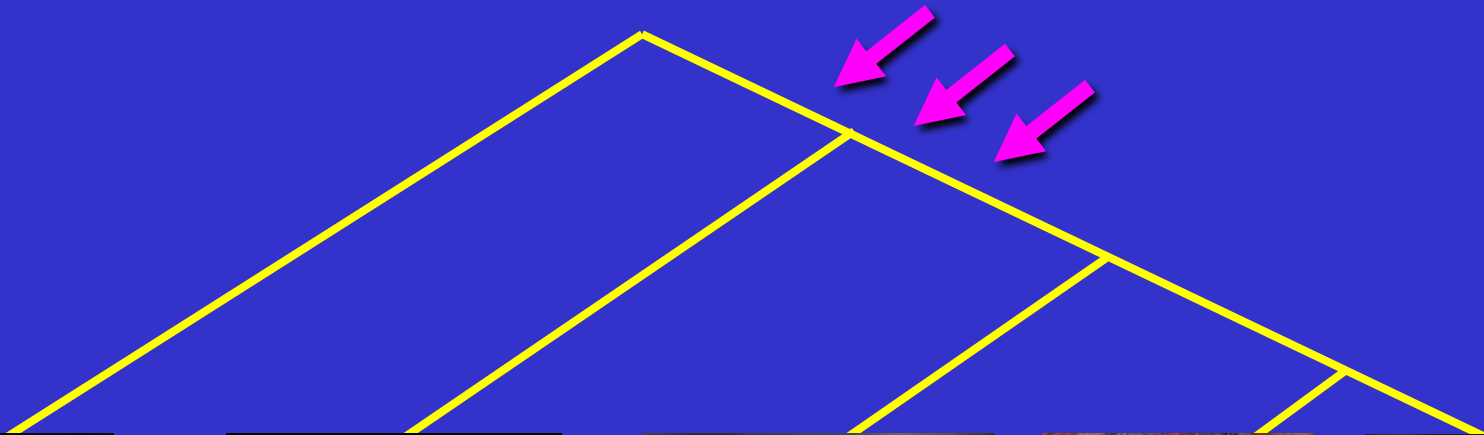
**Dwarf Lemur**

**Tarsier**





Means that at some point in our distant evolutionary past:



Lemurs & Lorises



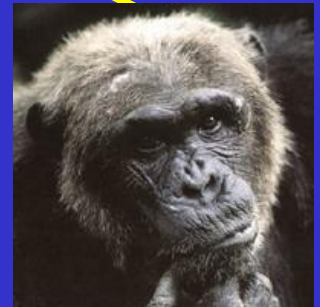
Omomyoids



Tarsiers

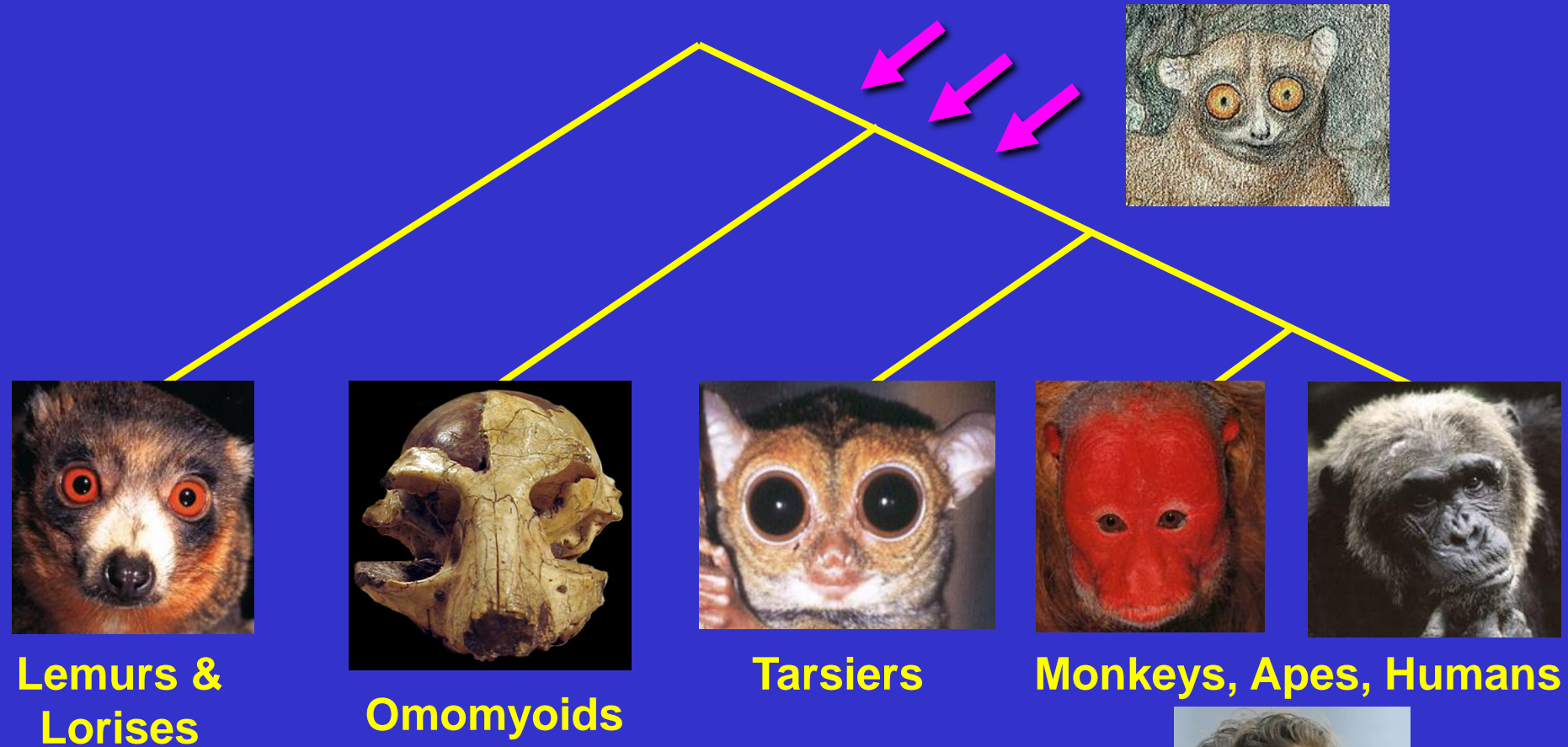


Monkeys, Apes, Humans





Means that at some point in our distant evolutionary past:



There were probably nocturnal bug eaters!



## Take-home messages:

1. If you're an insect, consider somewhere other than Sulawesi for a tropical vacation
2. Tarsiers are superlative in nearly every aspect of their anatomy
3. Tarsiers are have been around for a loooooong time (at least 45 million years)
4. Omomyoids probably *weren't* fossil tarsiers
5. That's OK because they shed light on the earliest stages of haplorhine evolution



## Special Thanks To:

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