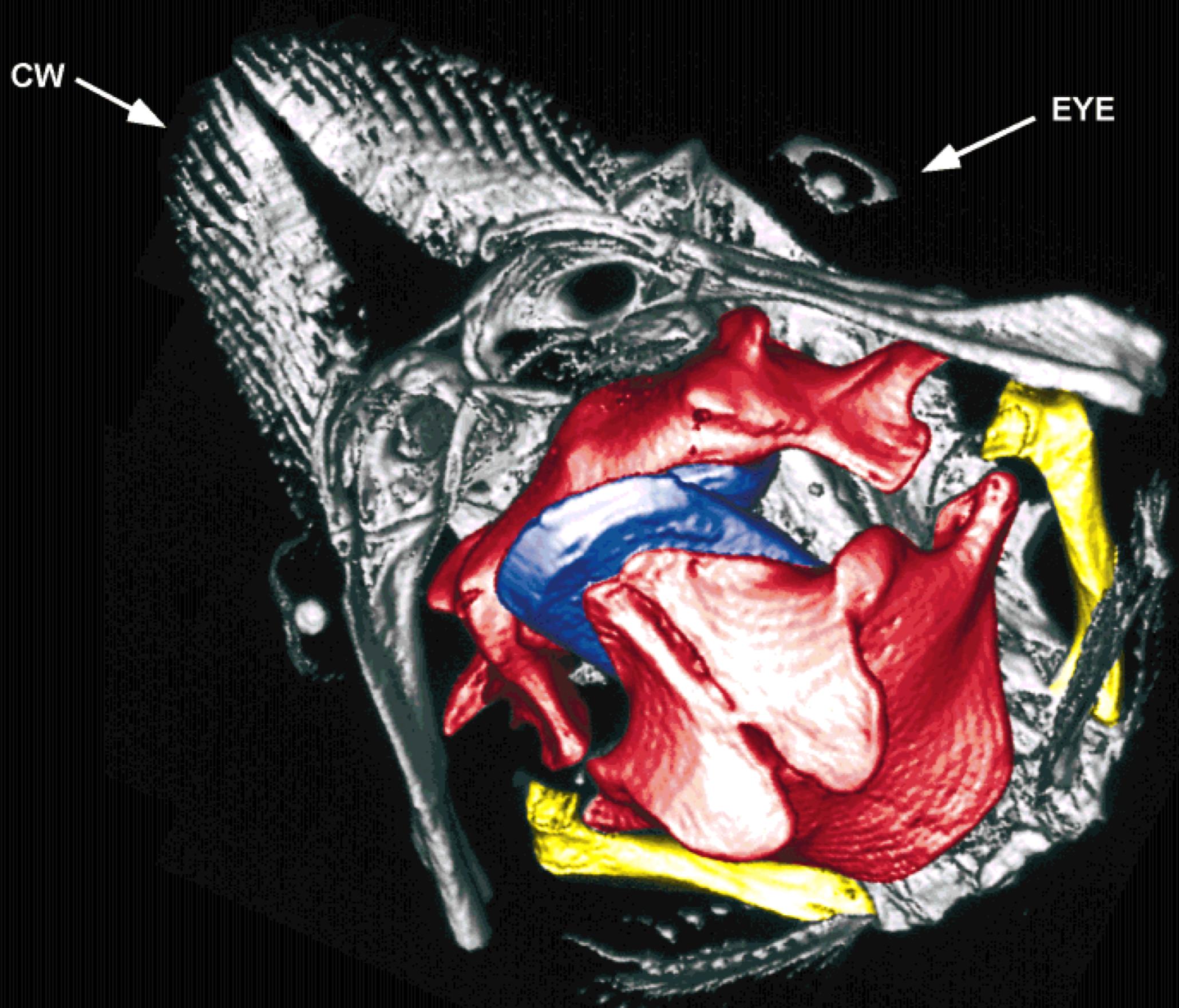
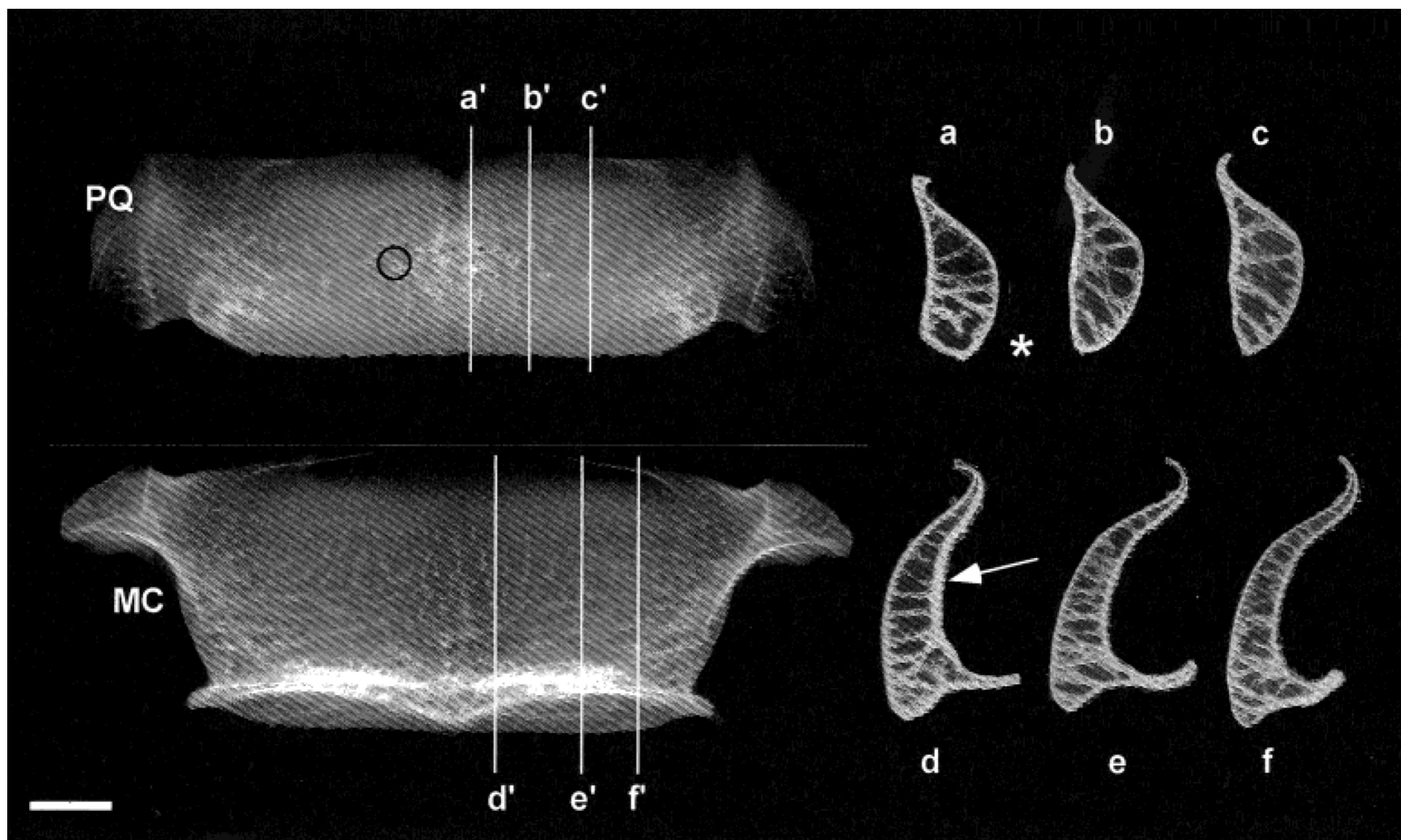


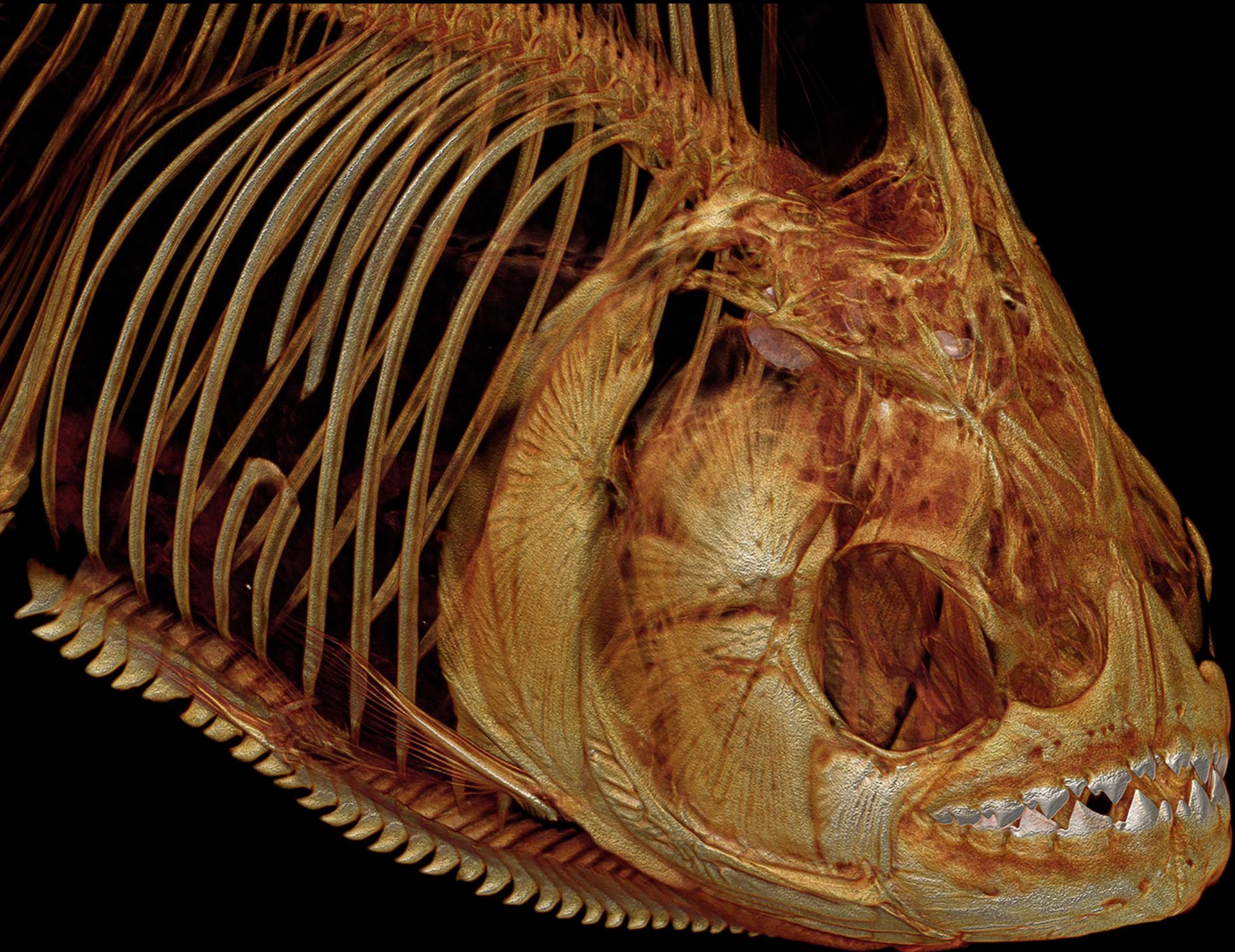




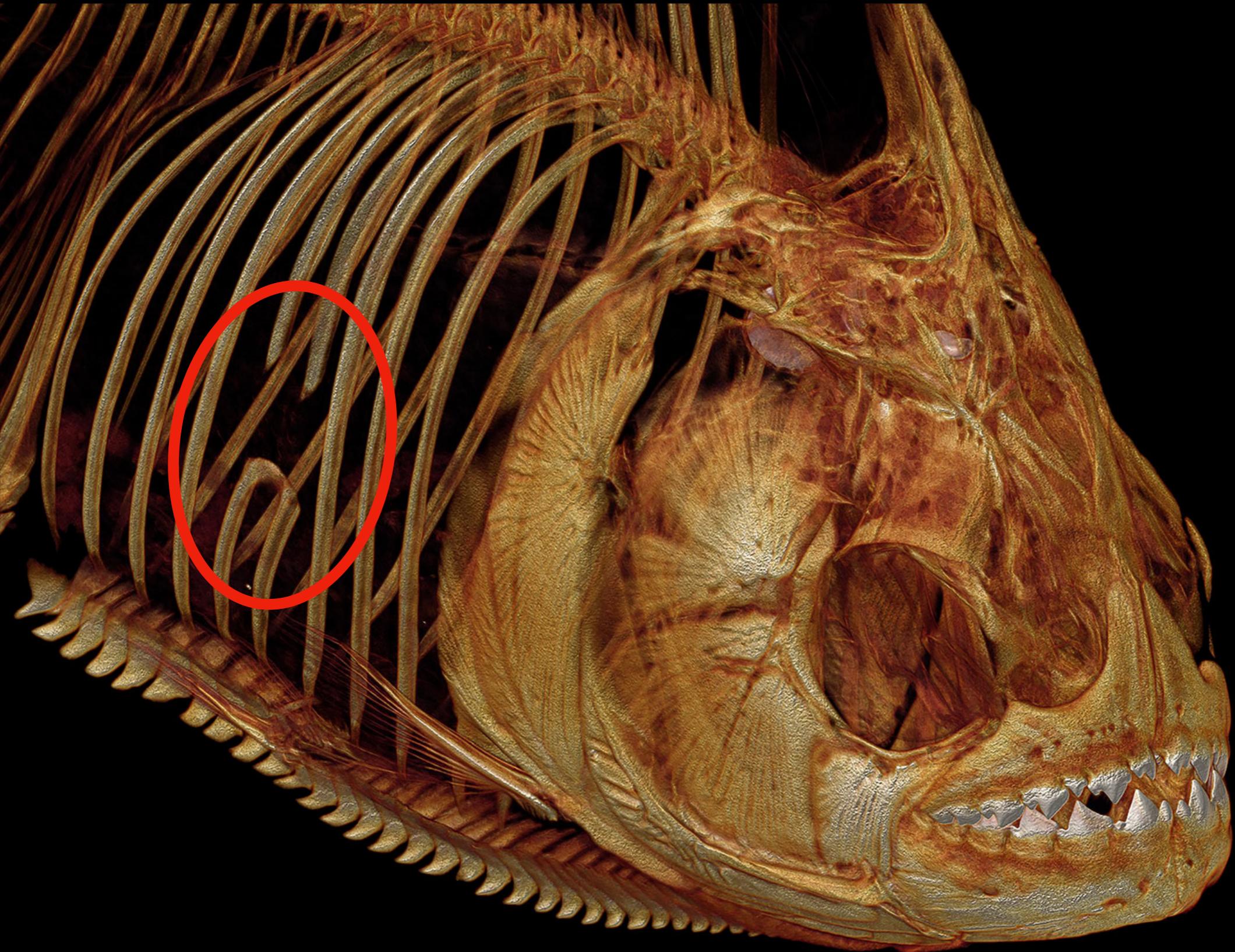
Just looking...





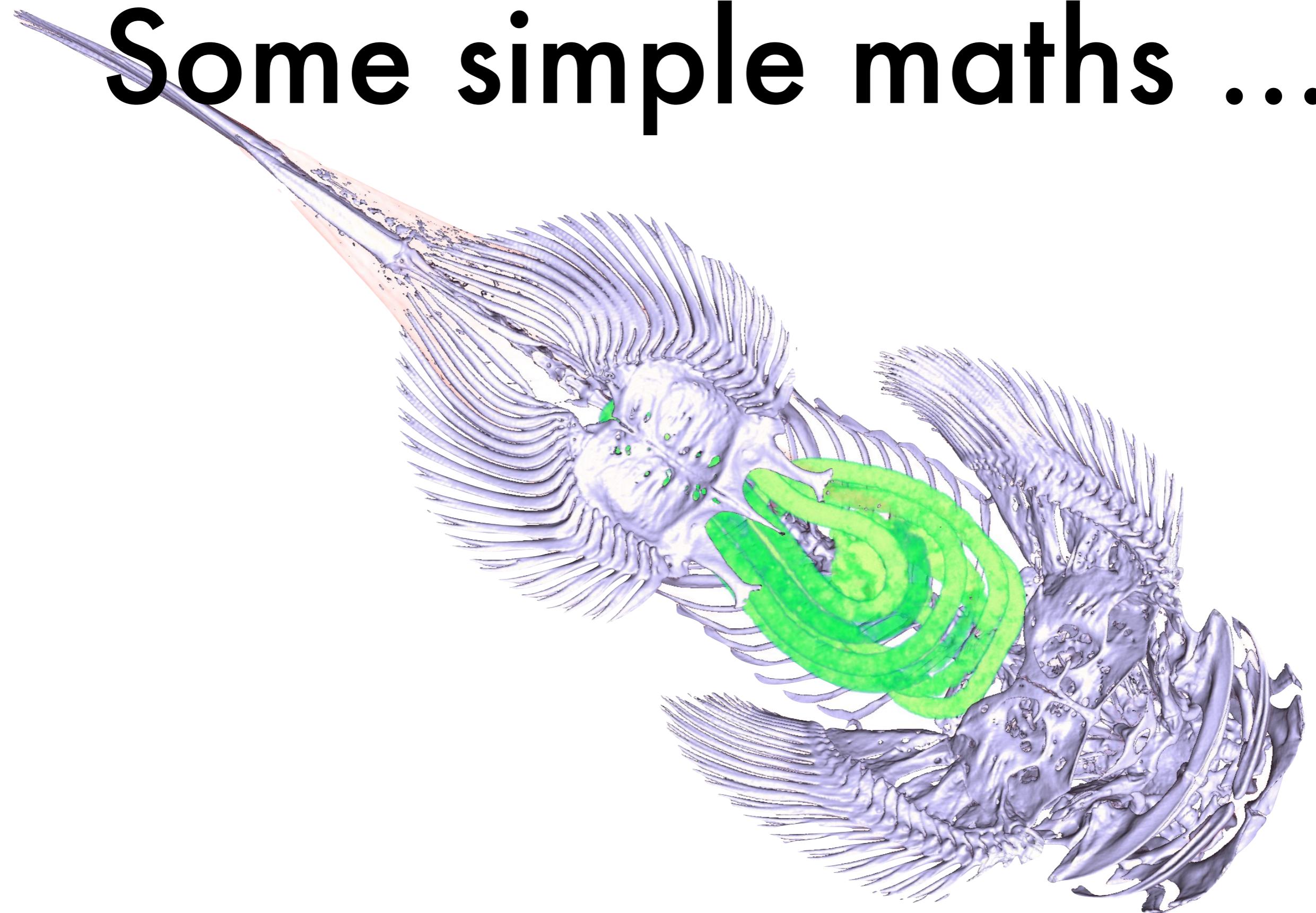


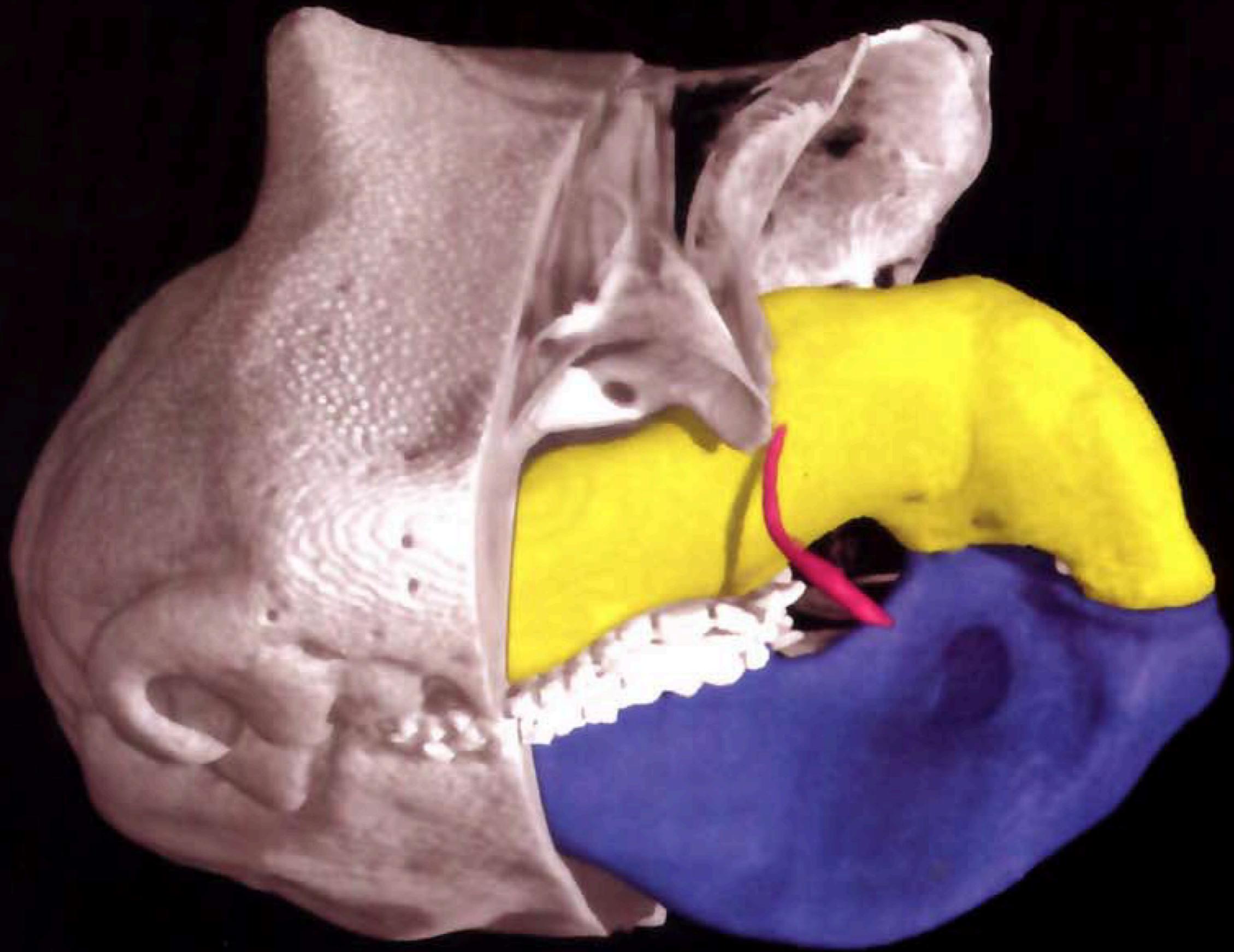
**Matt Kolmann**



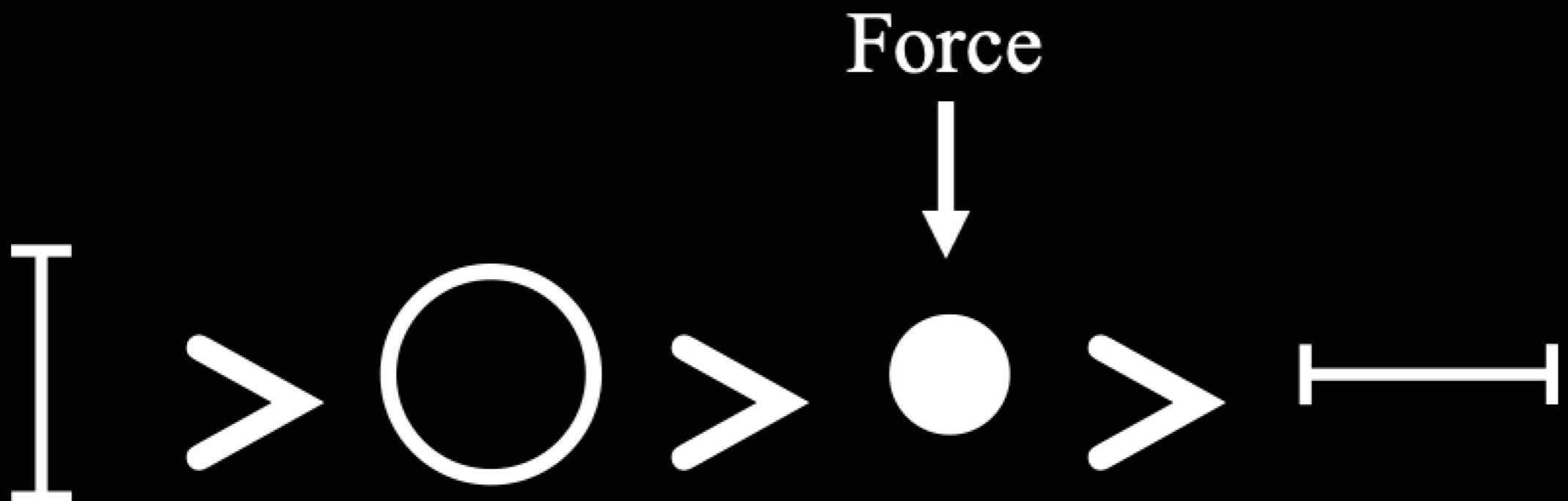
**Matt Kolmann**

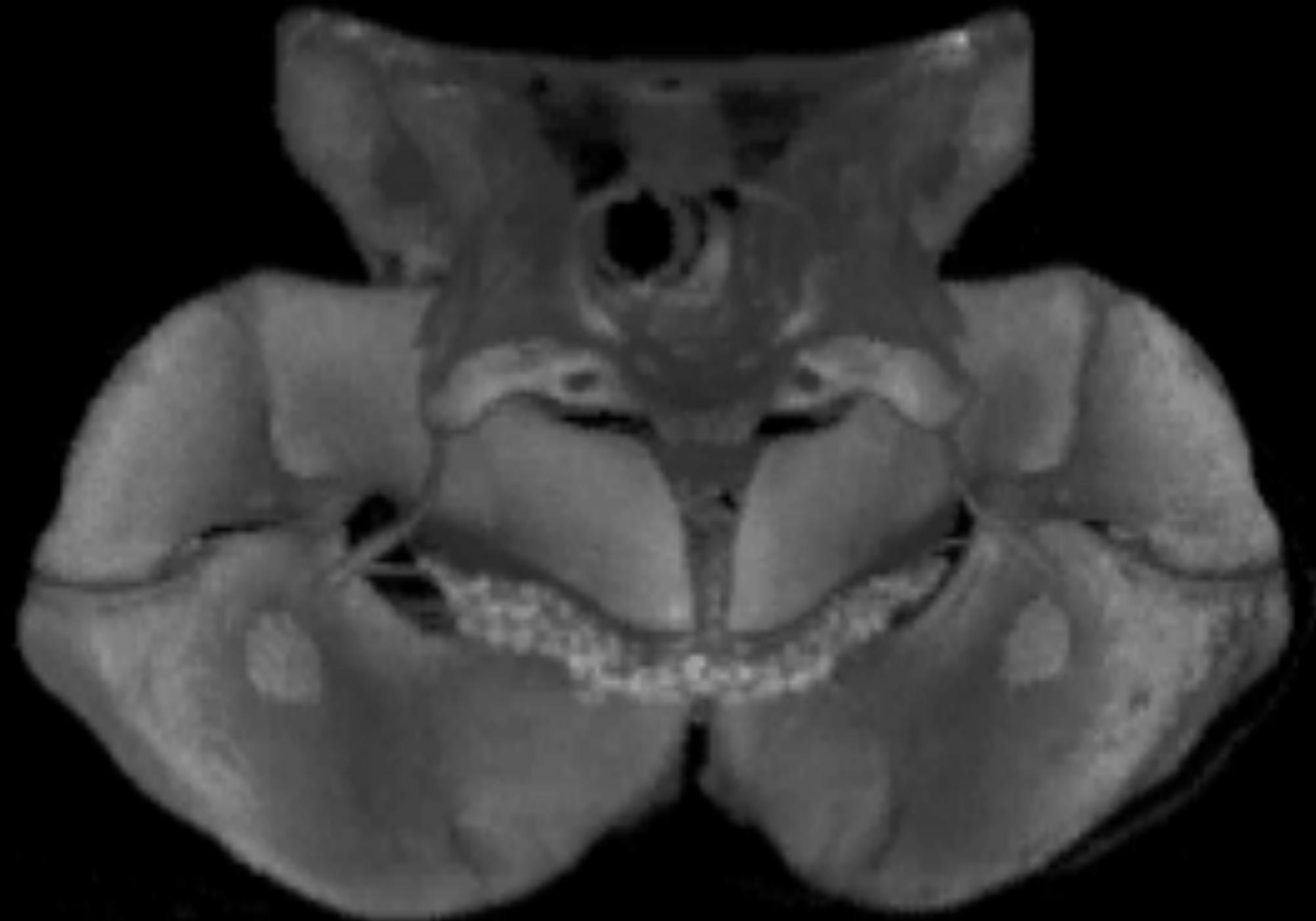
# Some simple maths ...

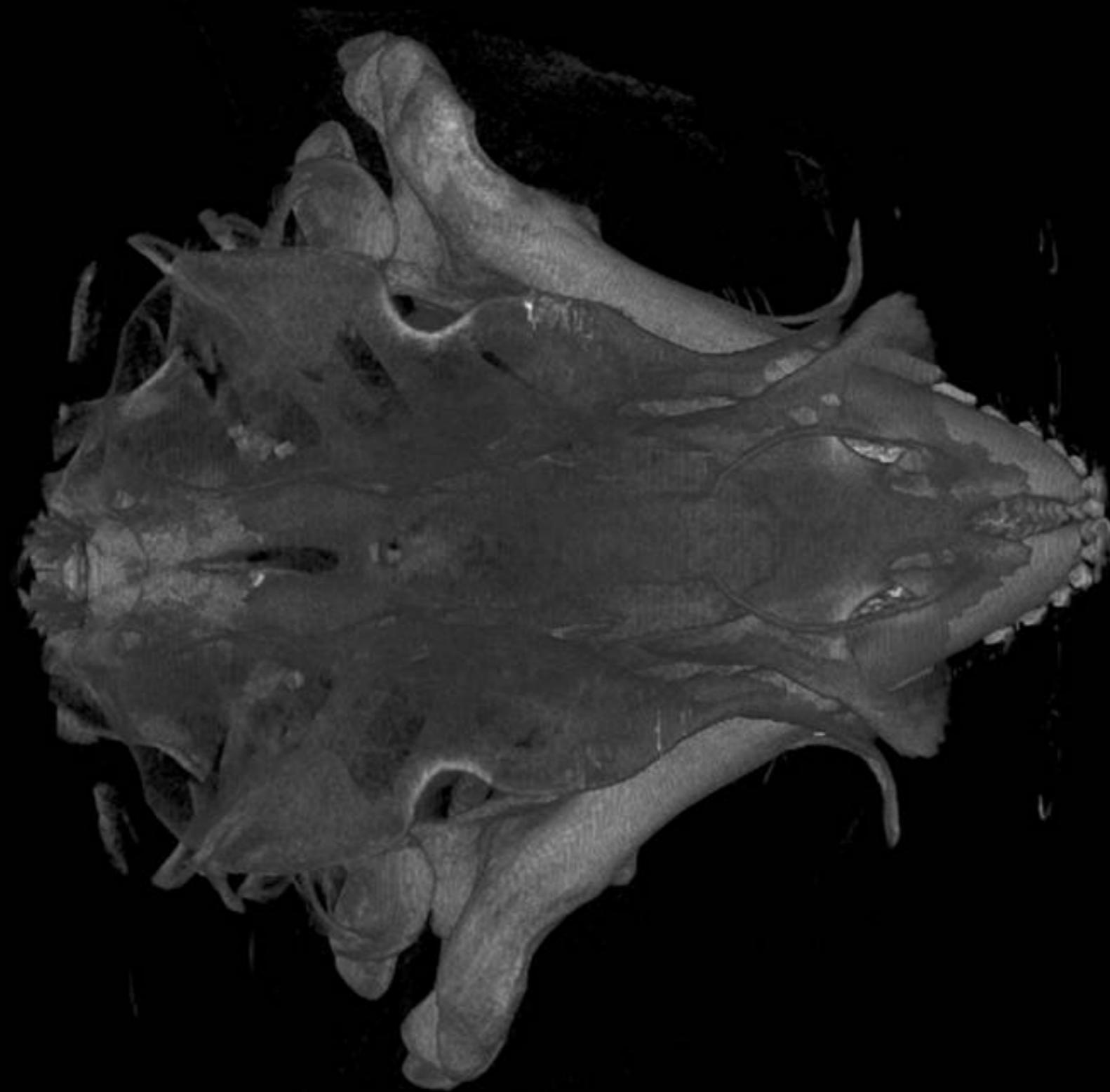


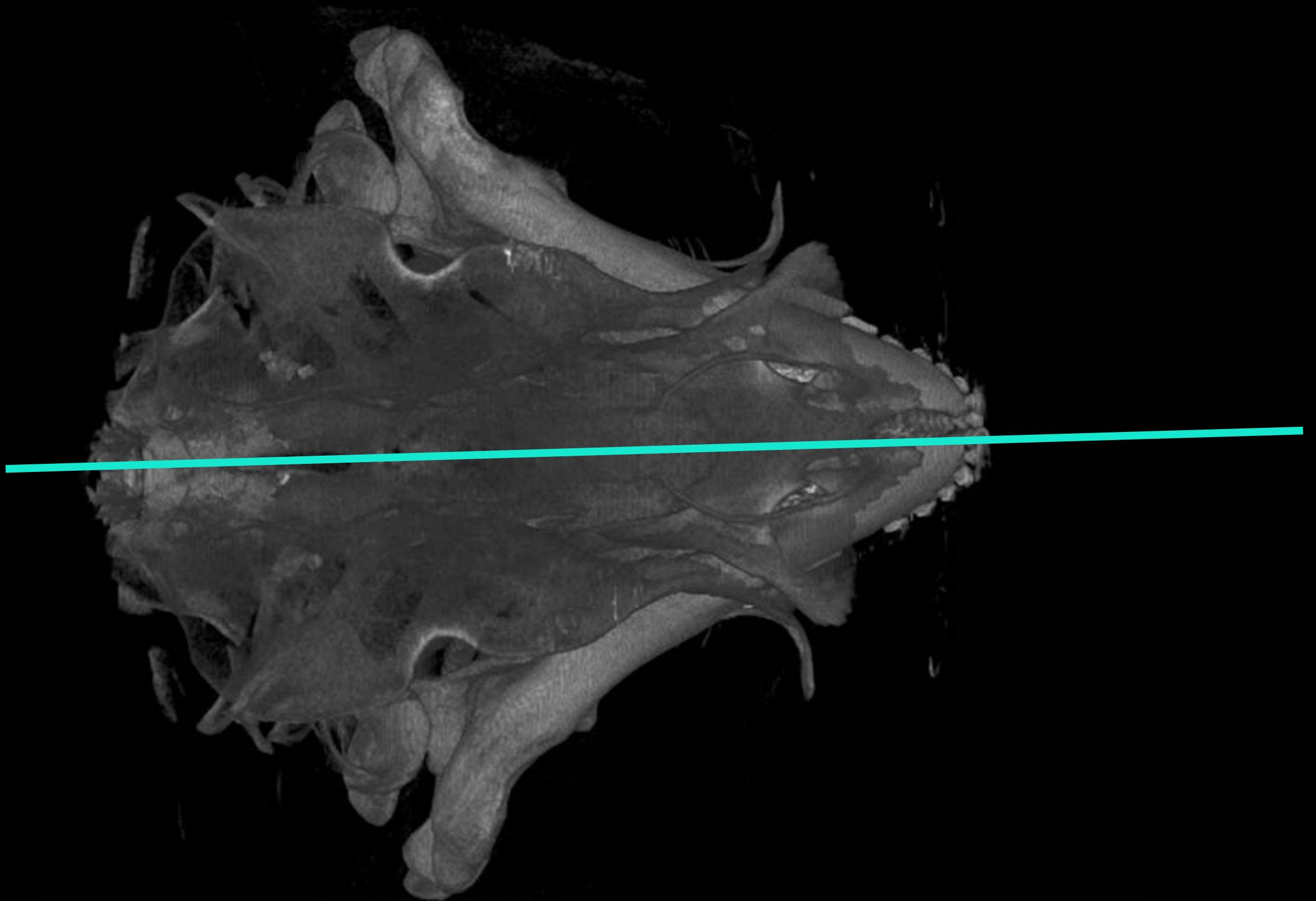


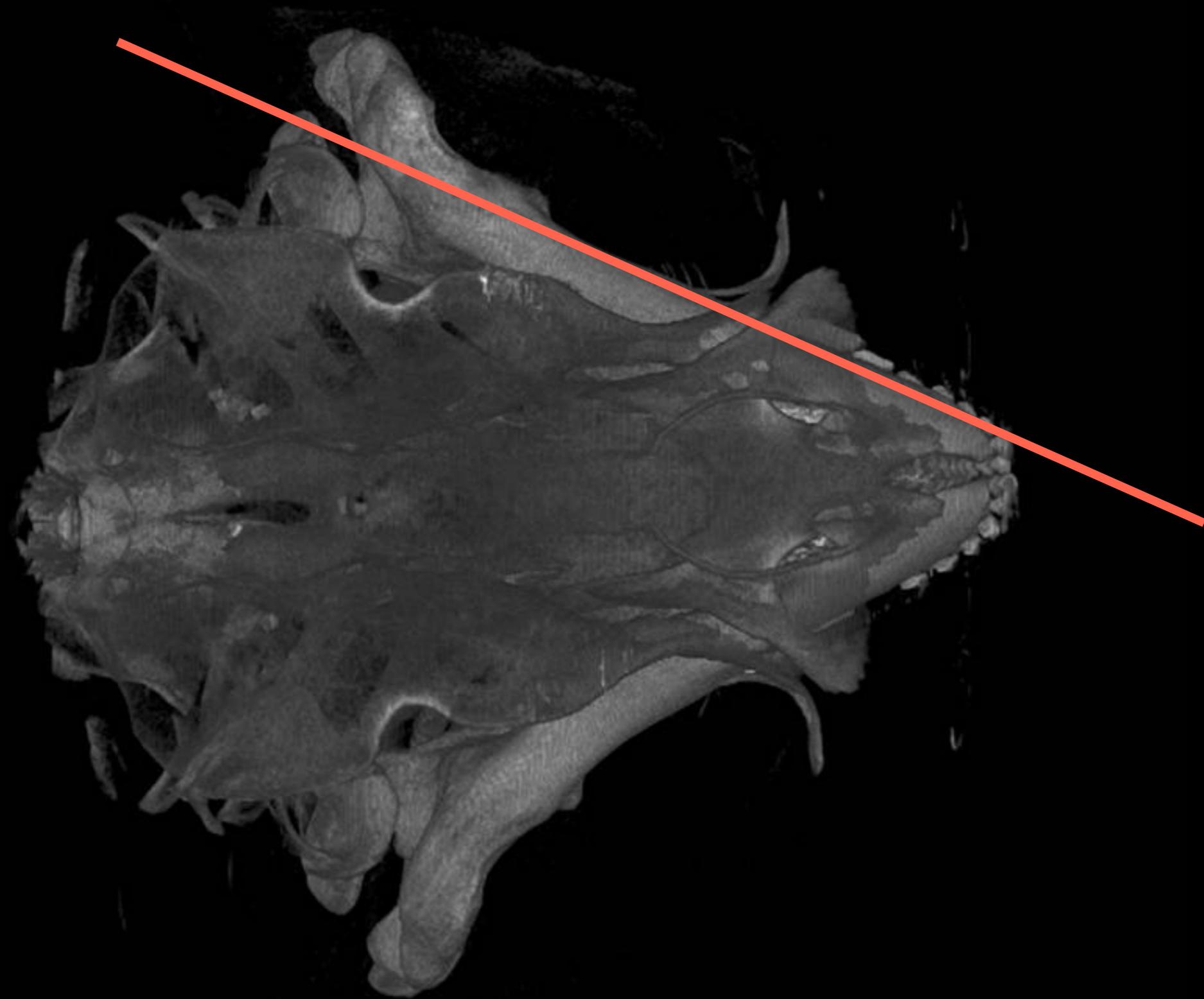
# Second Moment of Area

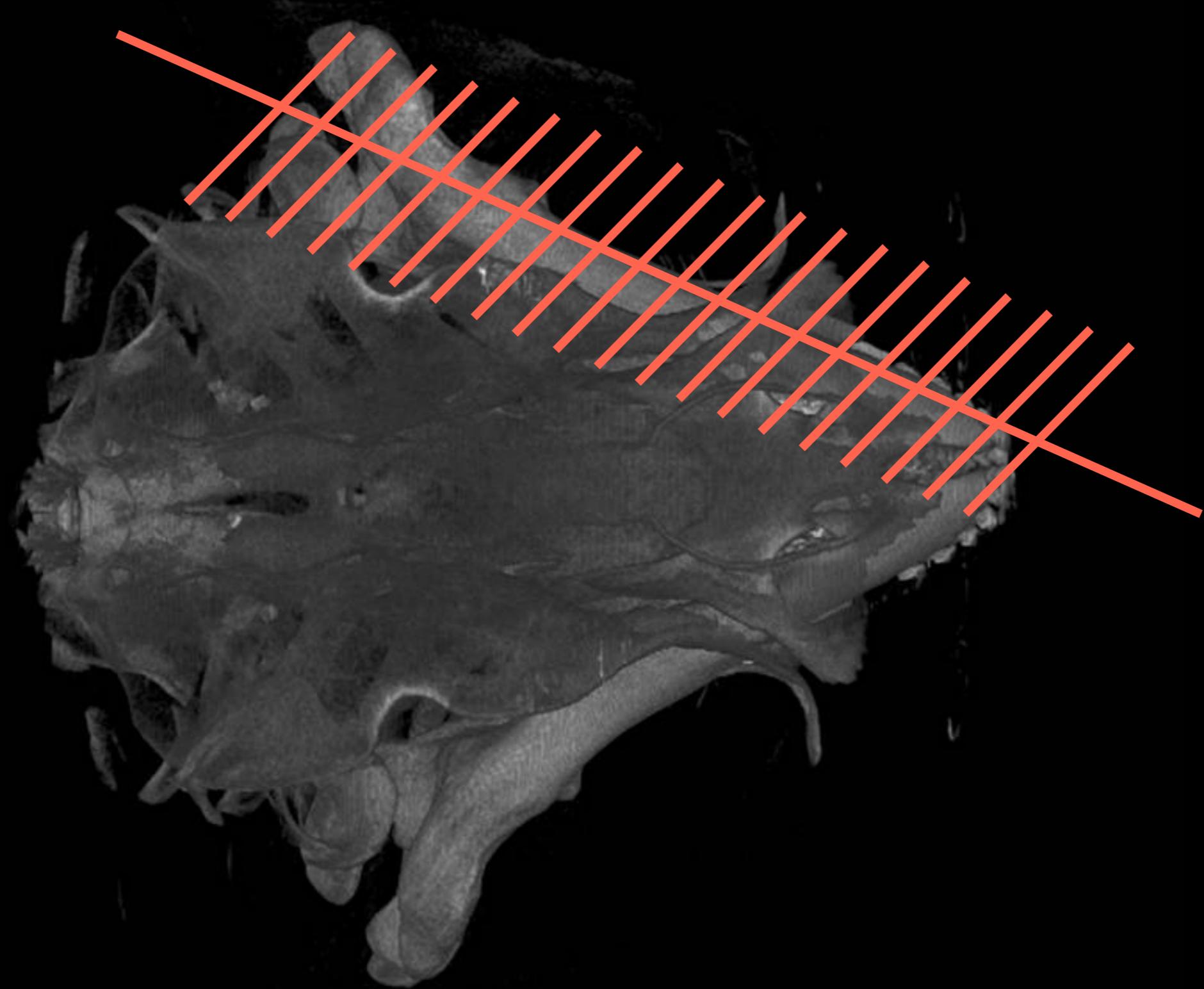




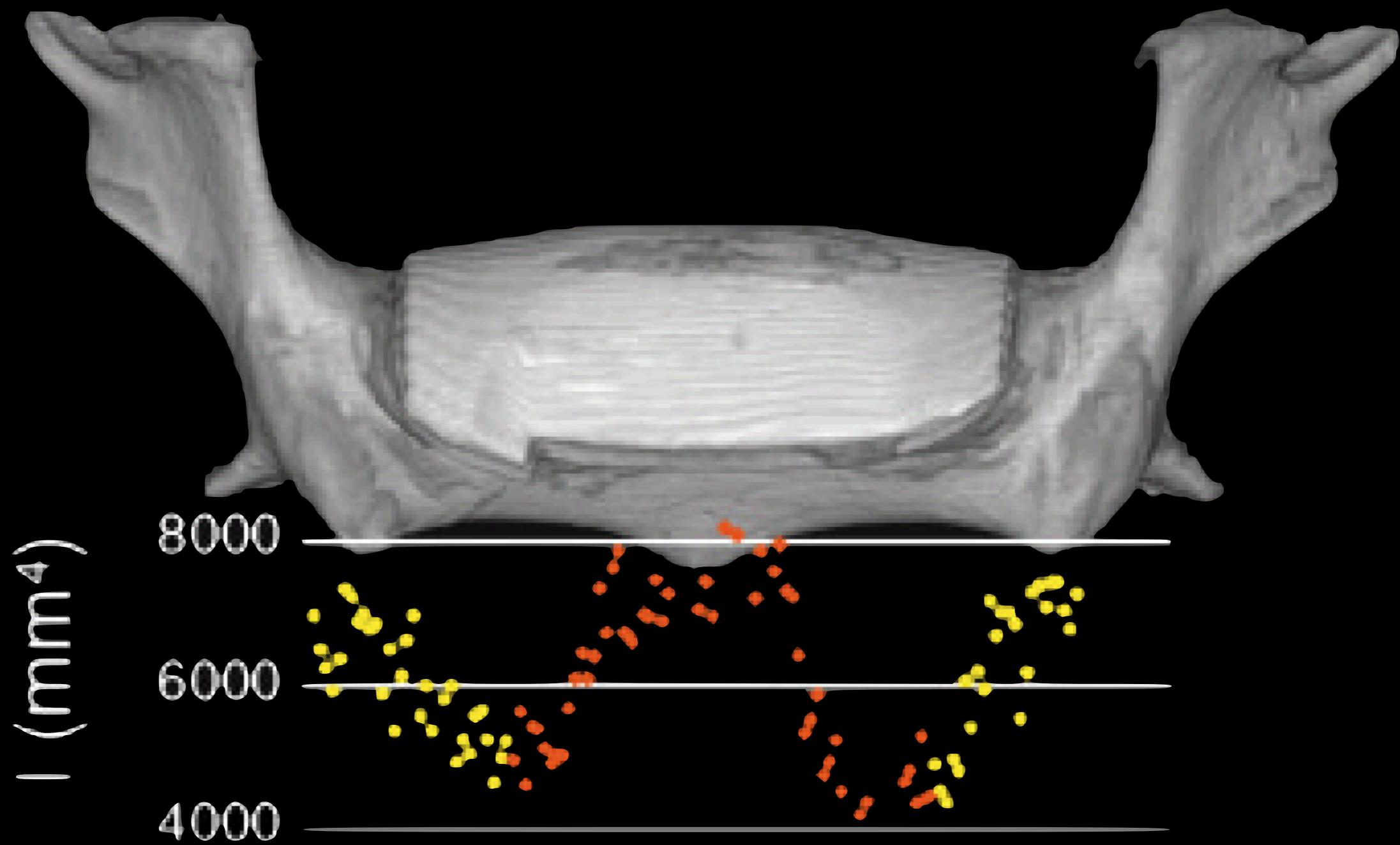




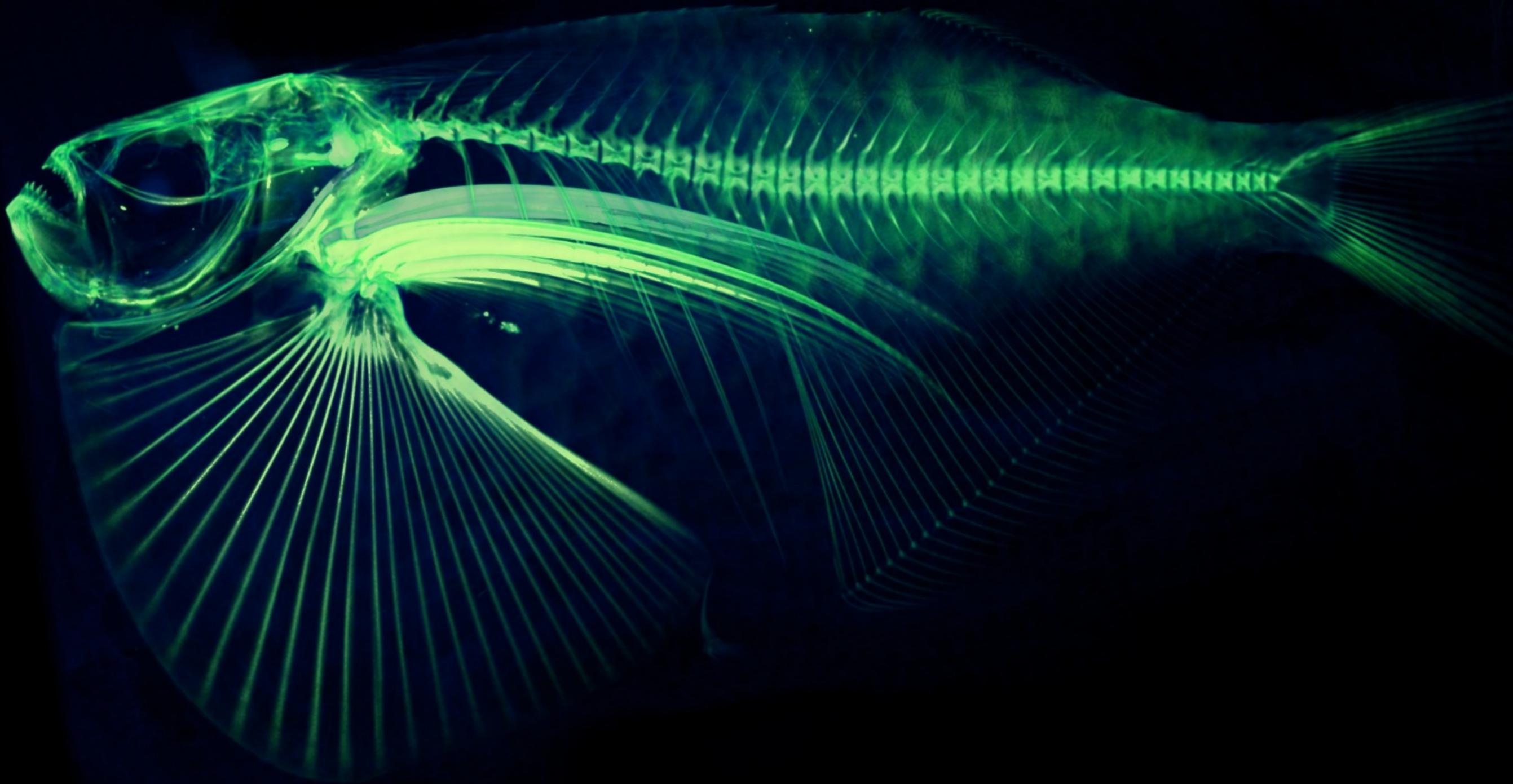




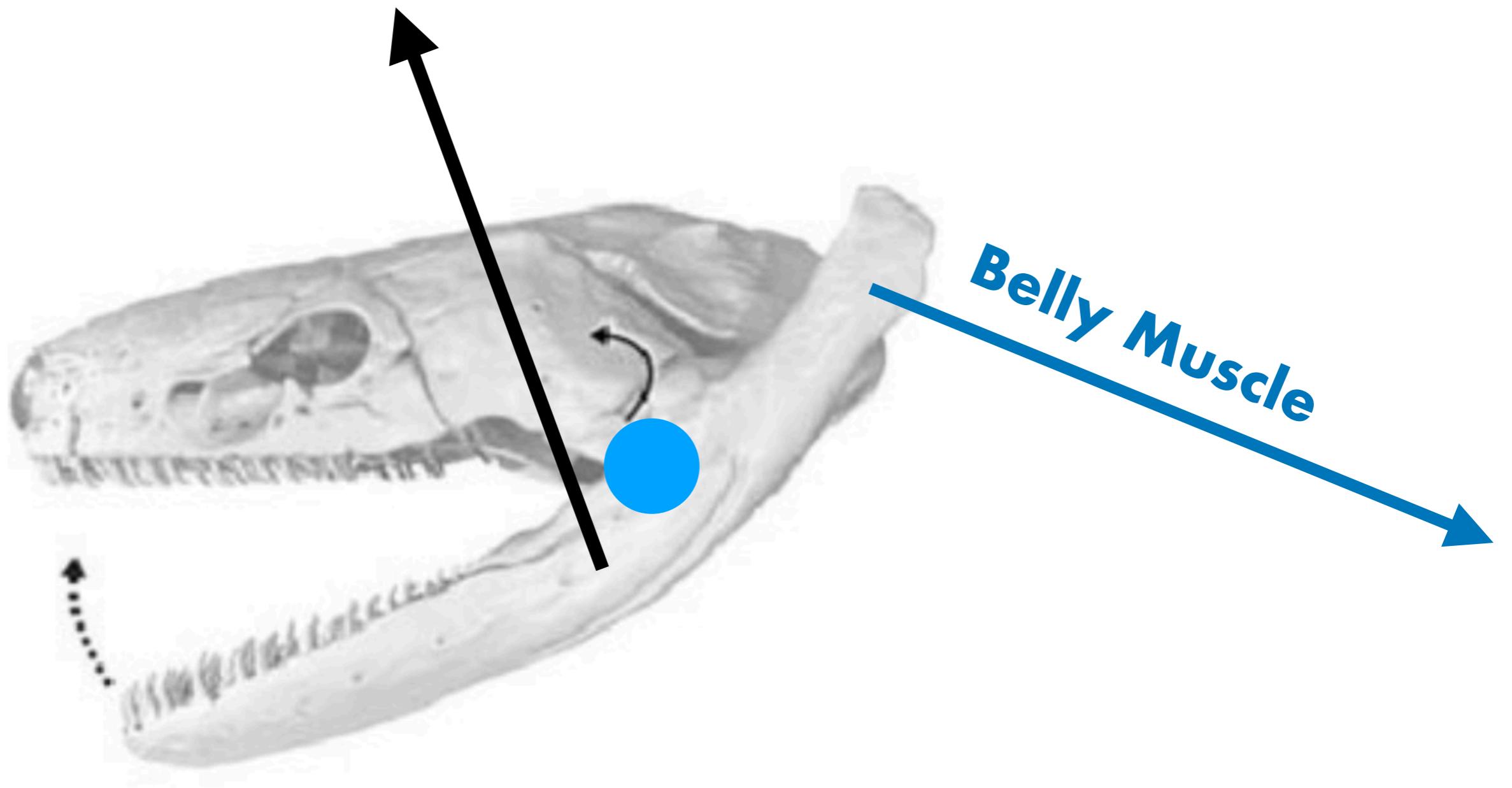




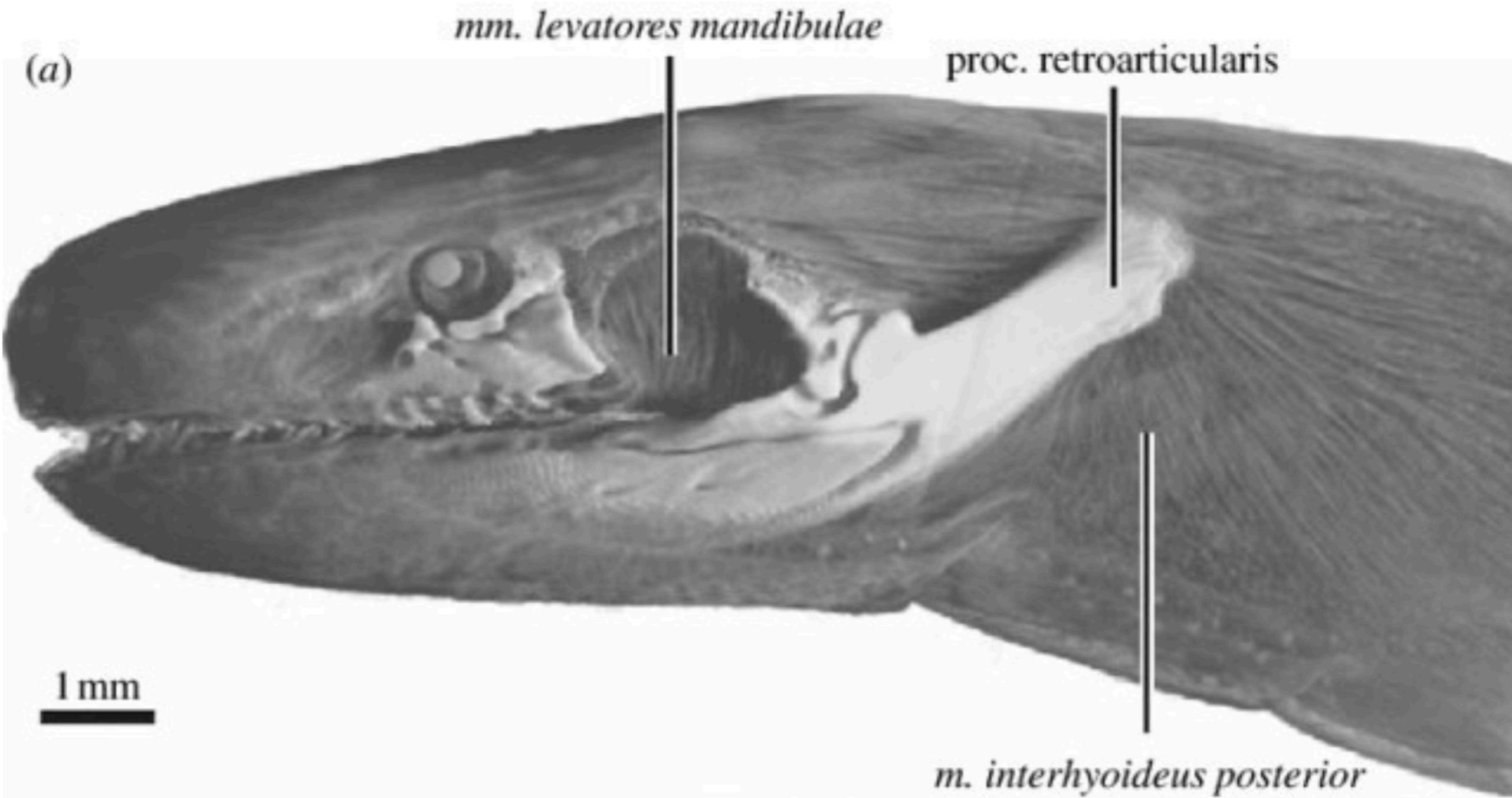
# Physiology and maths ...

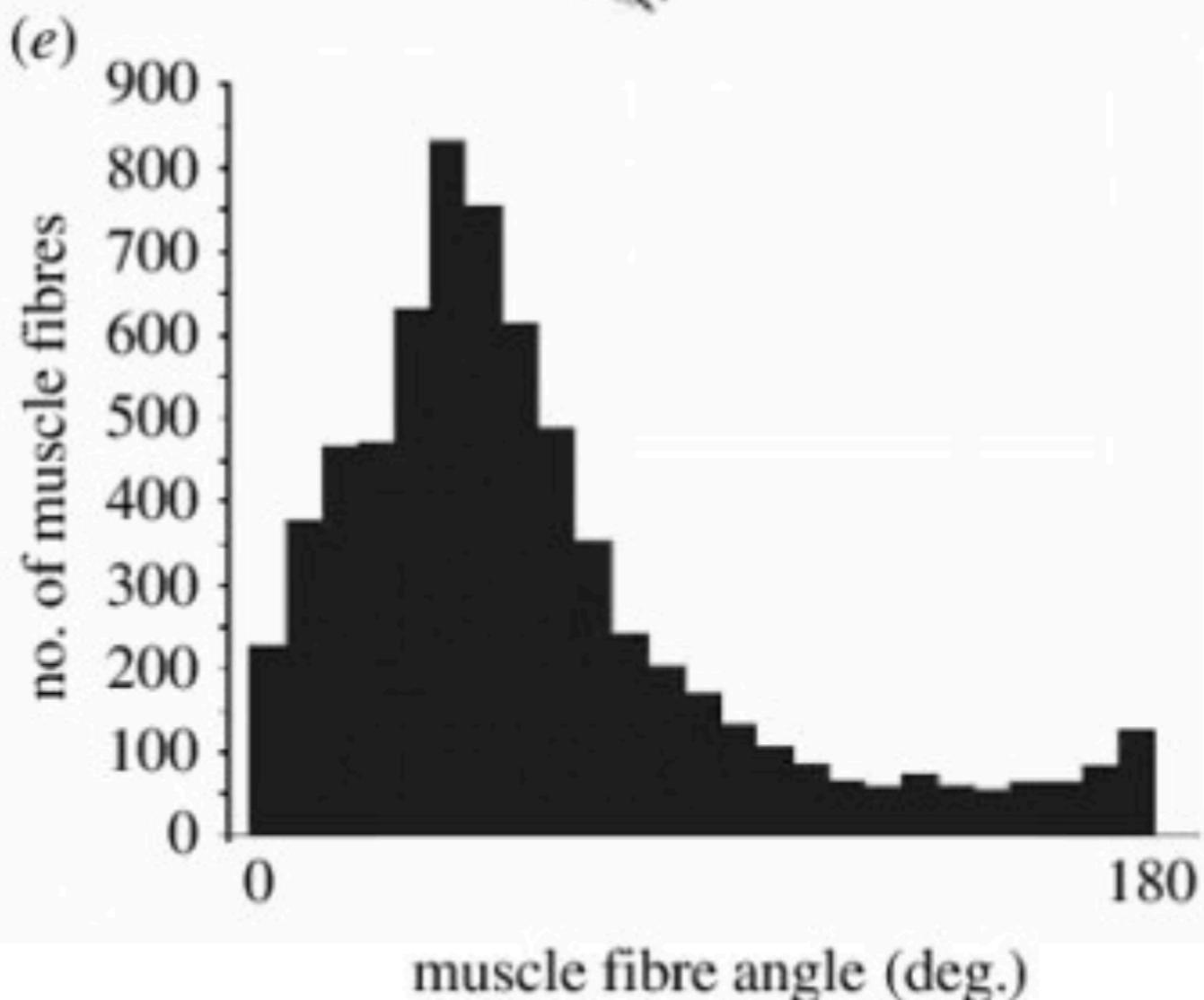
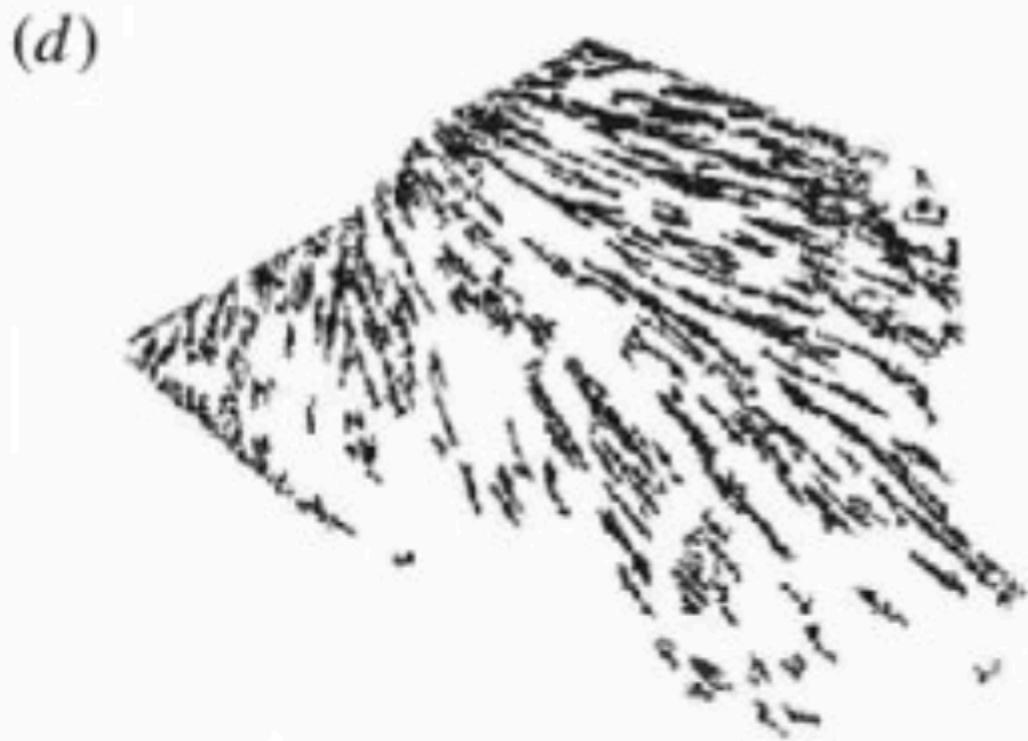
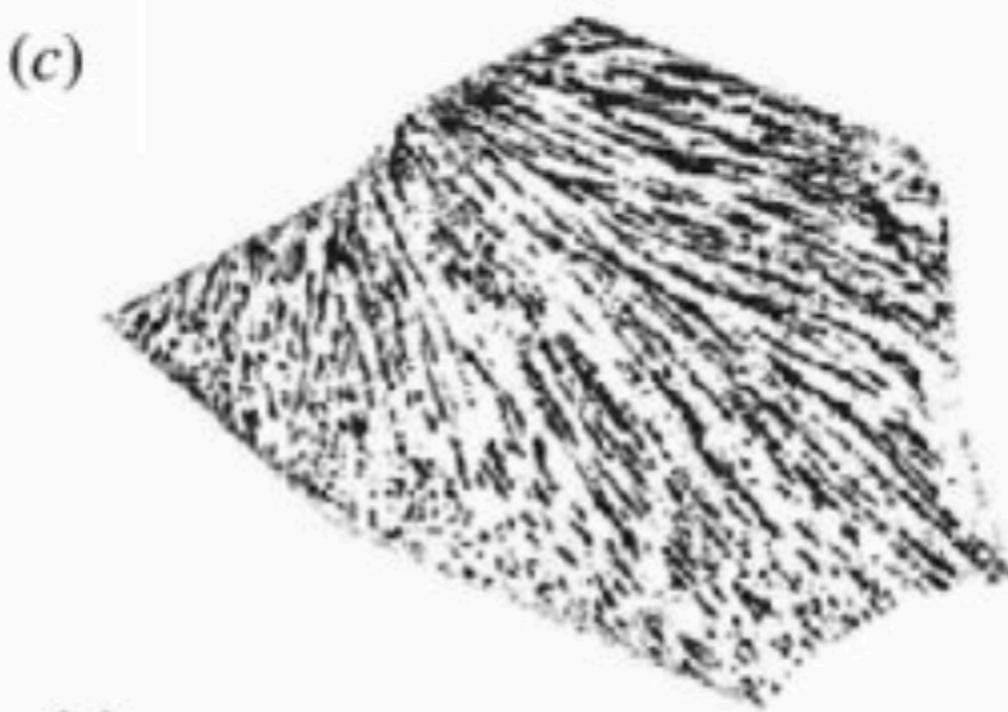


**Jaw Muscle**

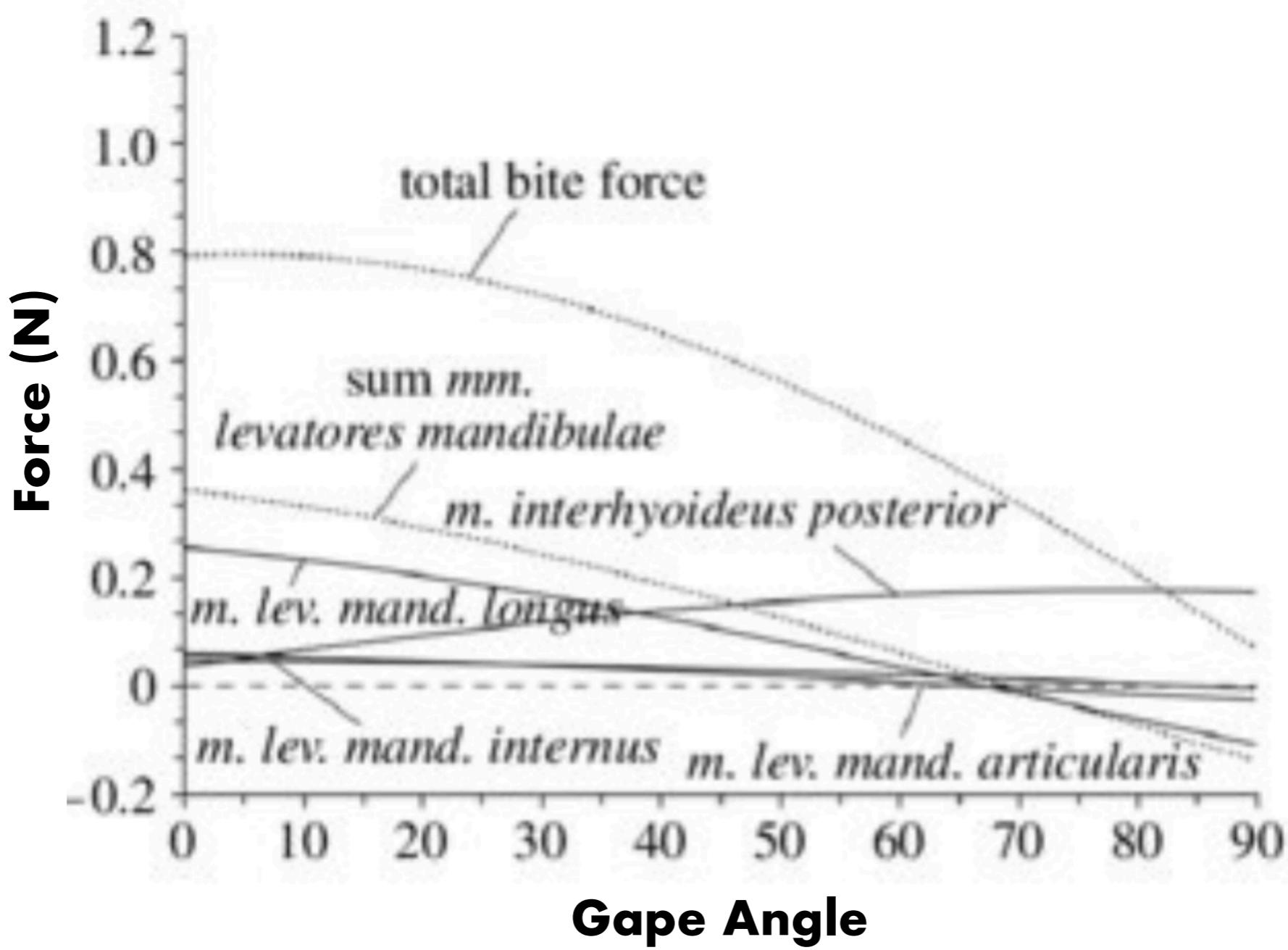


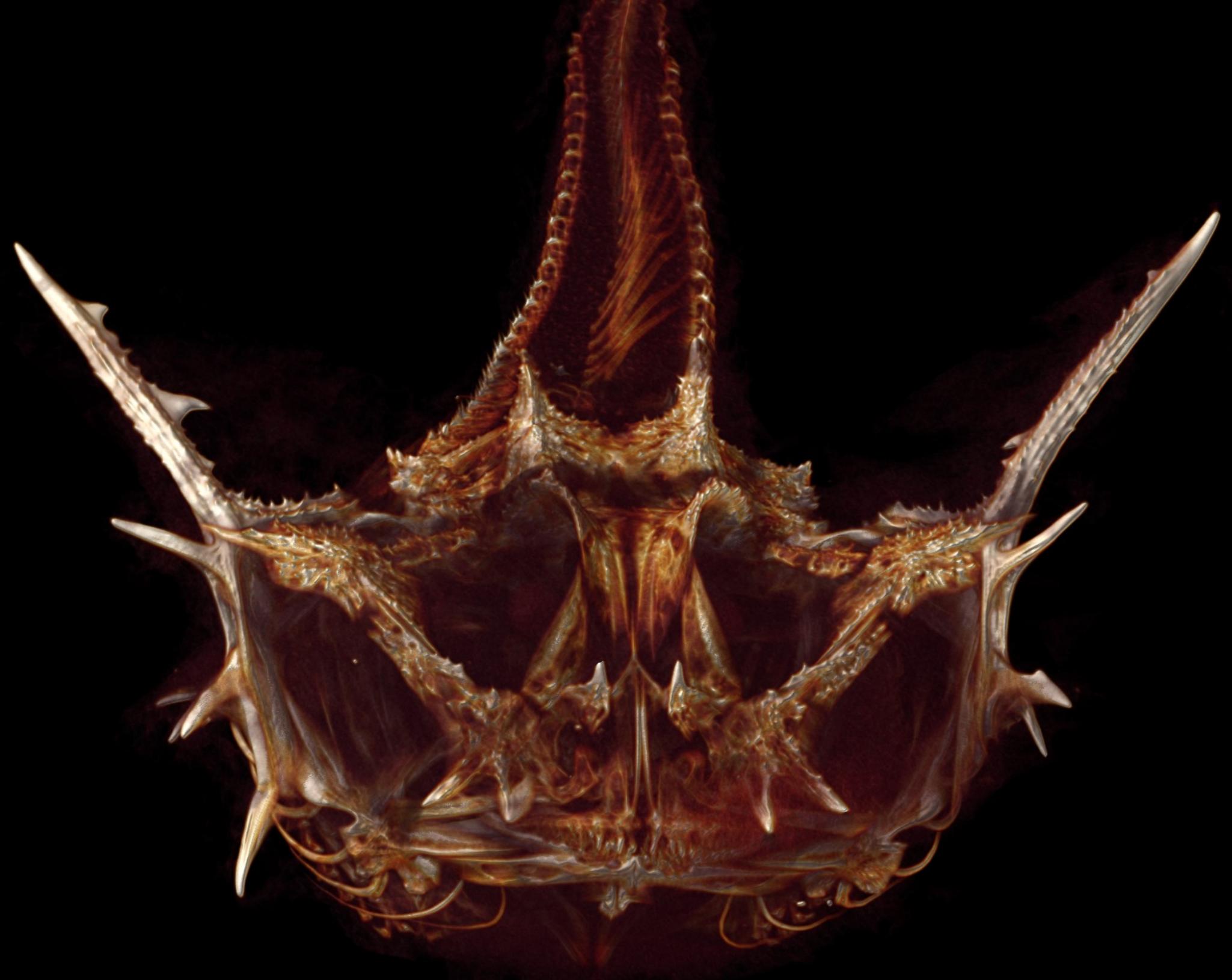
*Belly Muscle*





1 mm





Repetitive maths ...

Stegokrotaphic



Original architecture

*Ichthyophis cf. kohtaeoensis*



Zygokrotaphic

←  
deleting  
voxels



Stegokrotaphic

Original architecture

*Ichthyophis cf. kohtaeoensis*



Zygokrotaphic

←  
deleting  
voxels

Stegokrotaphic



adding  
voxels →

Akinetic



Original architecture

*Geotrypetes seraphini*



Original architecture

*Geotrypetes seraphini*

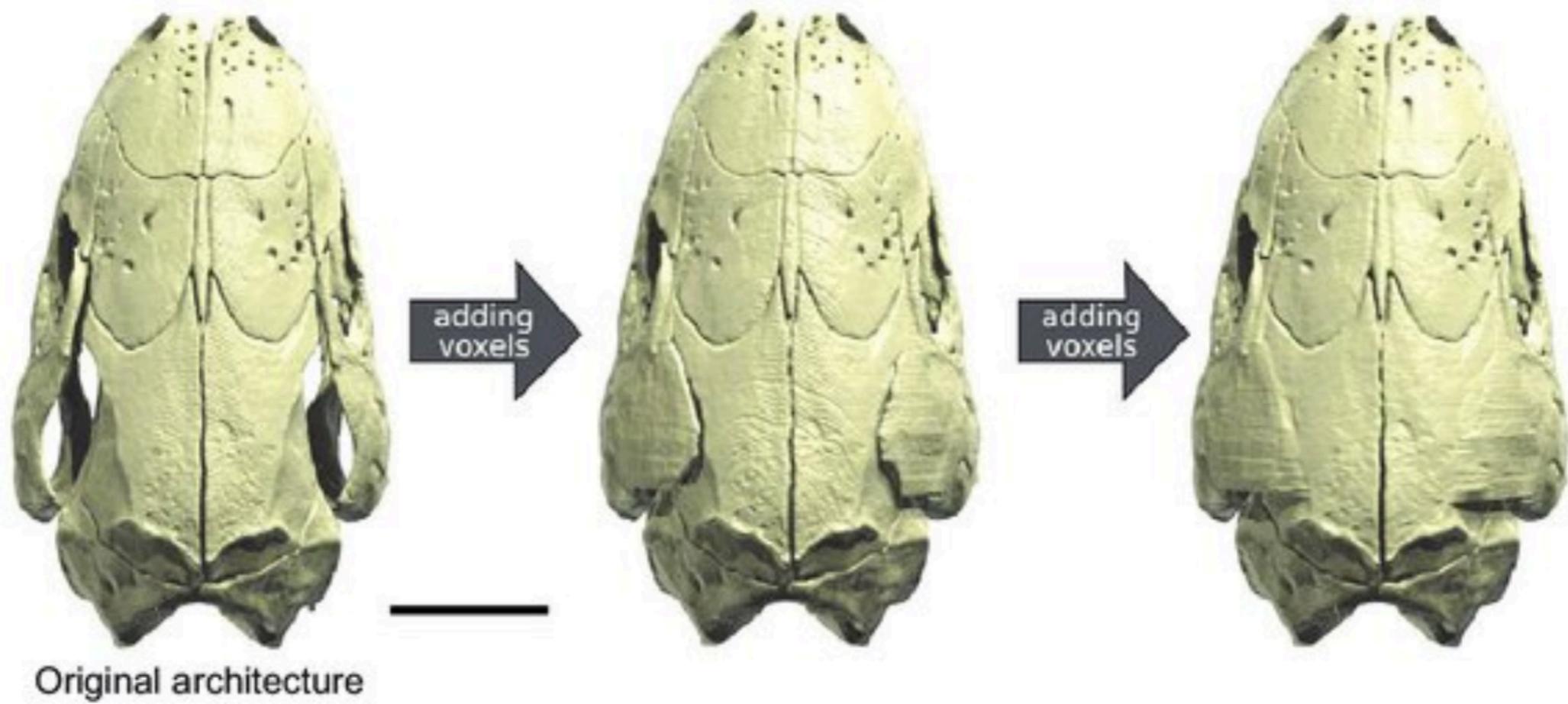


Original architecture

adding  
voxels



*Geotrypetes seraphini*

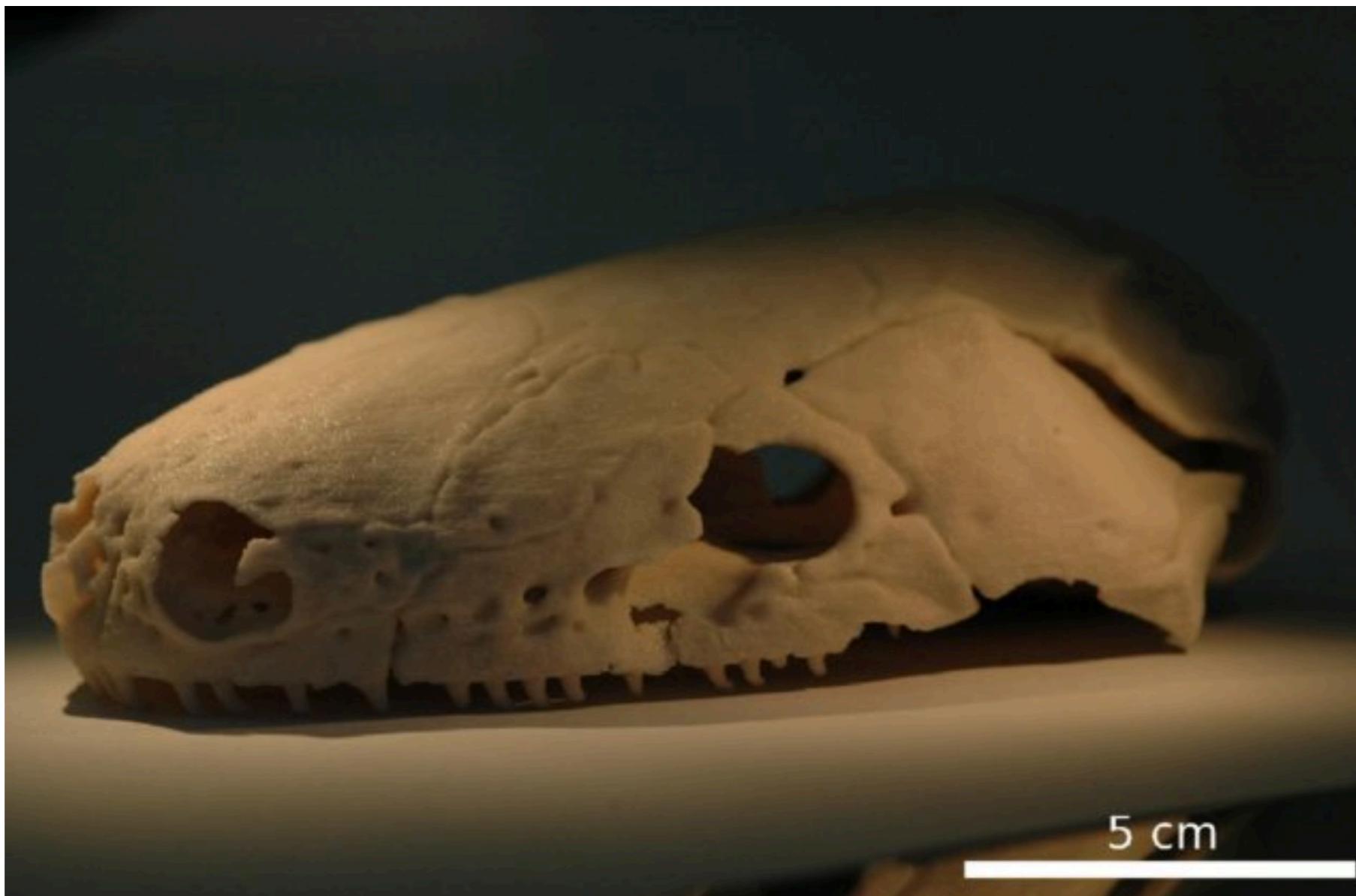


# Finite Element Analysis



# Finite Element Analysis

- Many easy computations.



# Finite Element Analysis

- Many easy computations.
- Holes in the skull don't matter.





# Physical Models



- Stingray barbs

- Stingray barbs
- Smashing skulls

- Stingray barbs
- Smashing skulls
- Stabbing spines

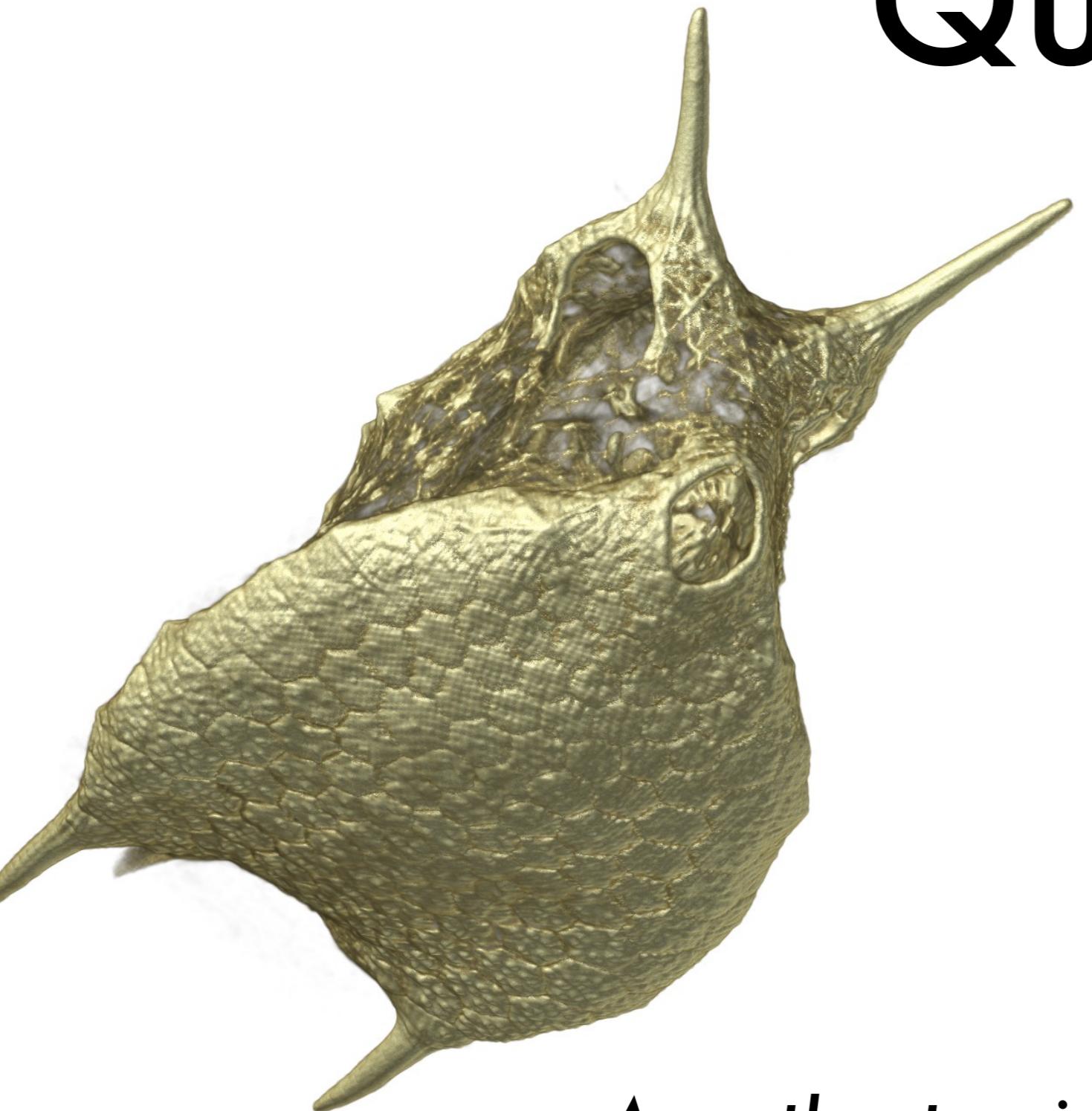
- Stingray barbs
- Smashing skulls
- Stabbing spines
- Swimming snailfish

- Stingray barbs
- Smashing skulls
- Stabbing spines
- Swimming snailfish
- Small anatomy BIG

- Stingray barbs
- Smashing skulls
- Stabbing spines
- Swimming snailfish
- Small anatomy BIG
- Sharp teeth

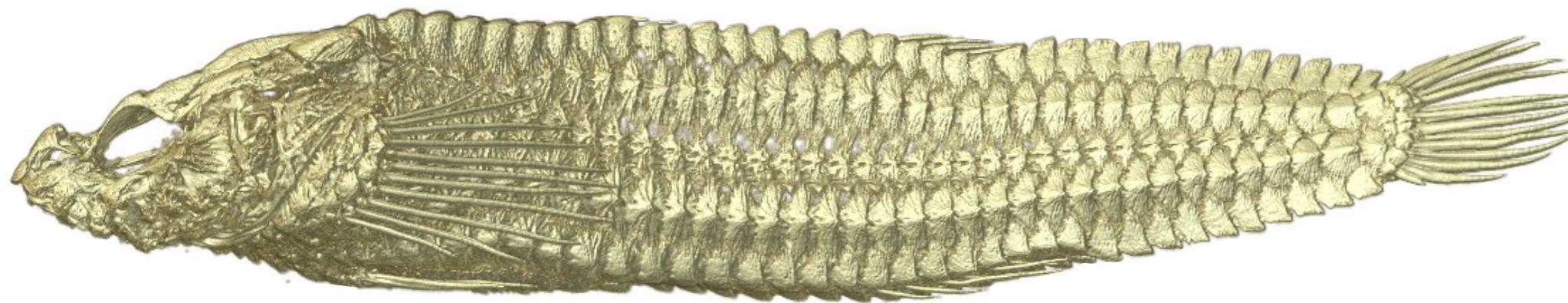
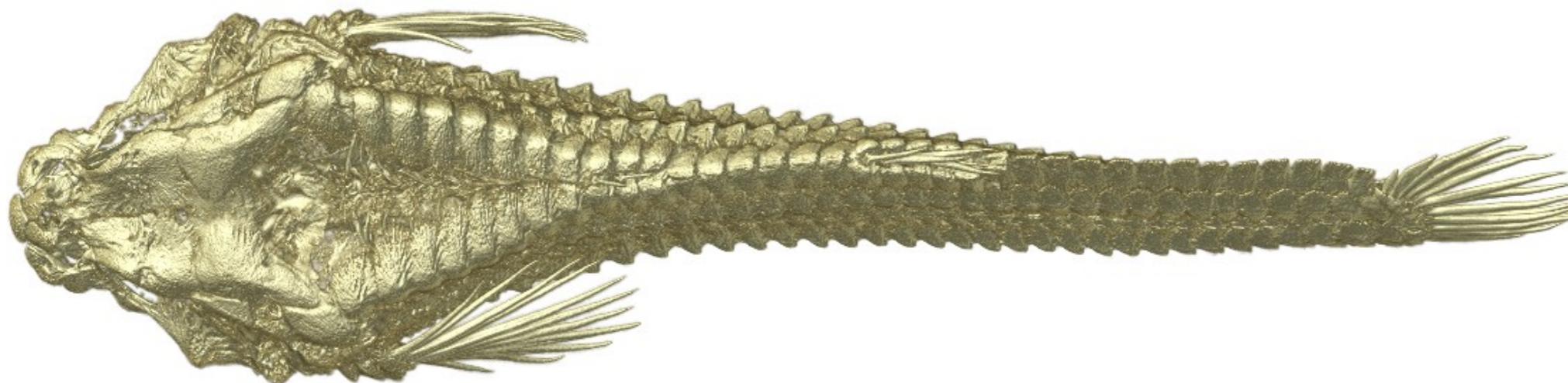
- Stingray barbs
- Smashing skulls
- Stabbing spines
- Swimming snailfish
- Small anatomy BIG
- Sharp teeth

# Quantification of Voxels



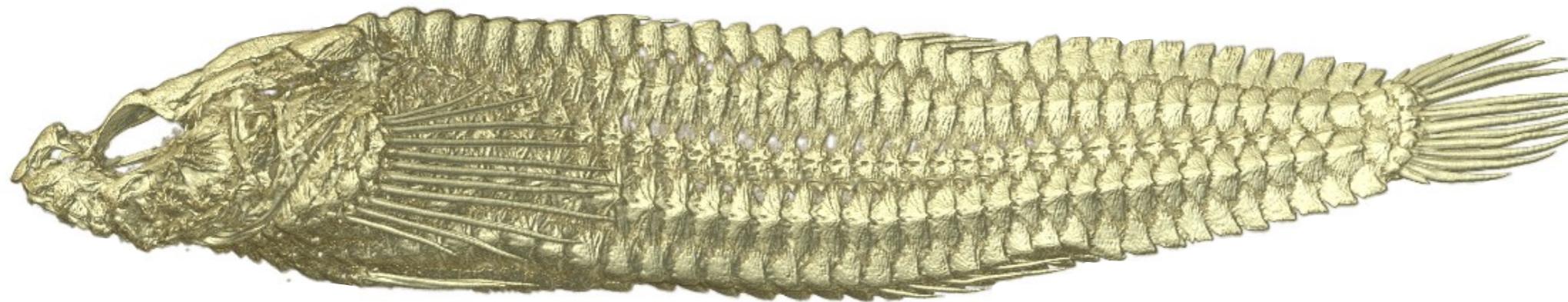
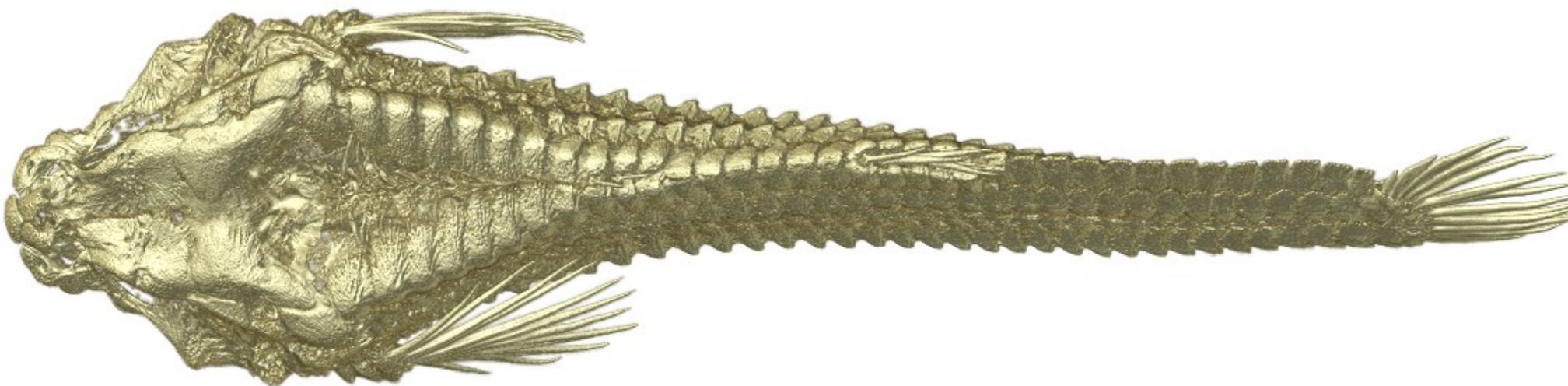
*Acanthostracion quadricornis*

# Poachers



*Bothragonidae*

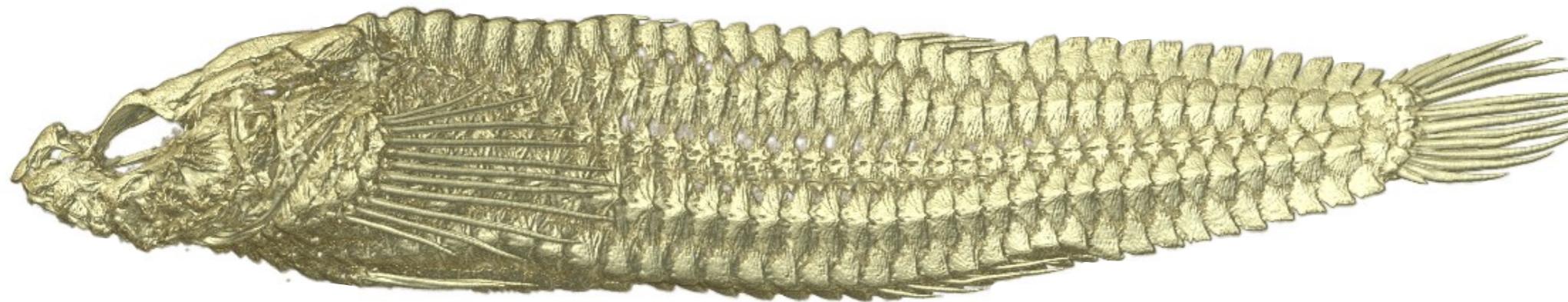
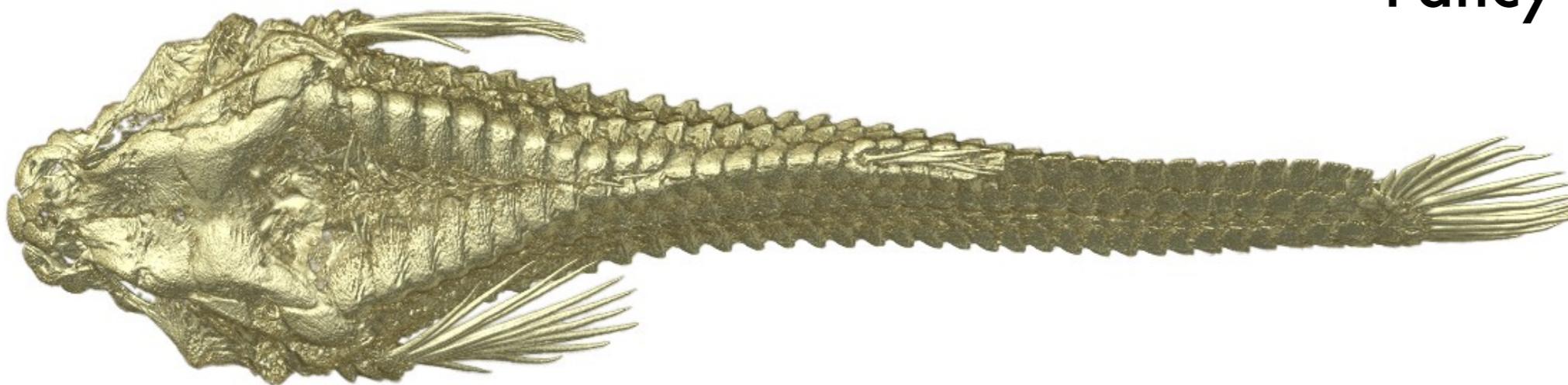
# Poachers. • Agonidae



*Bothragonus occidentalis*

# Poachers.

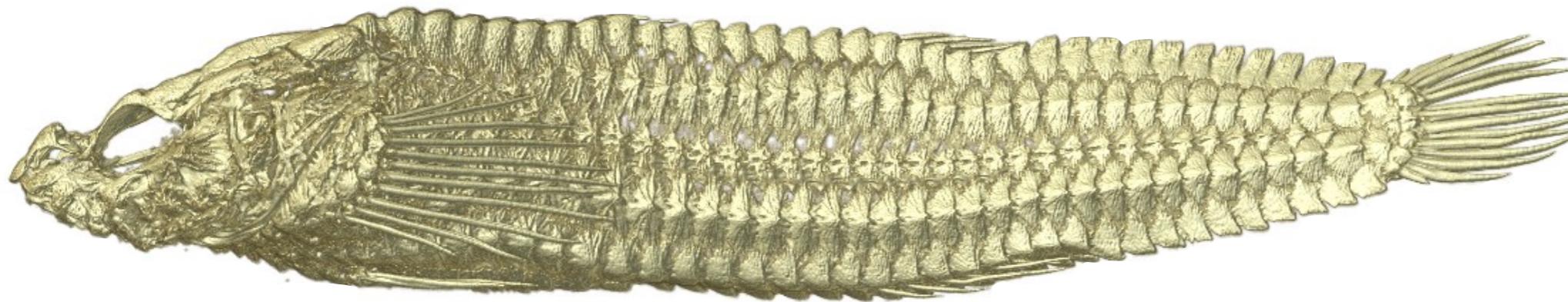
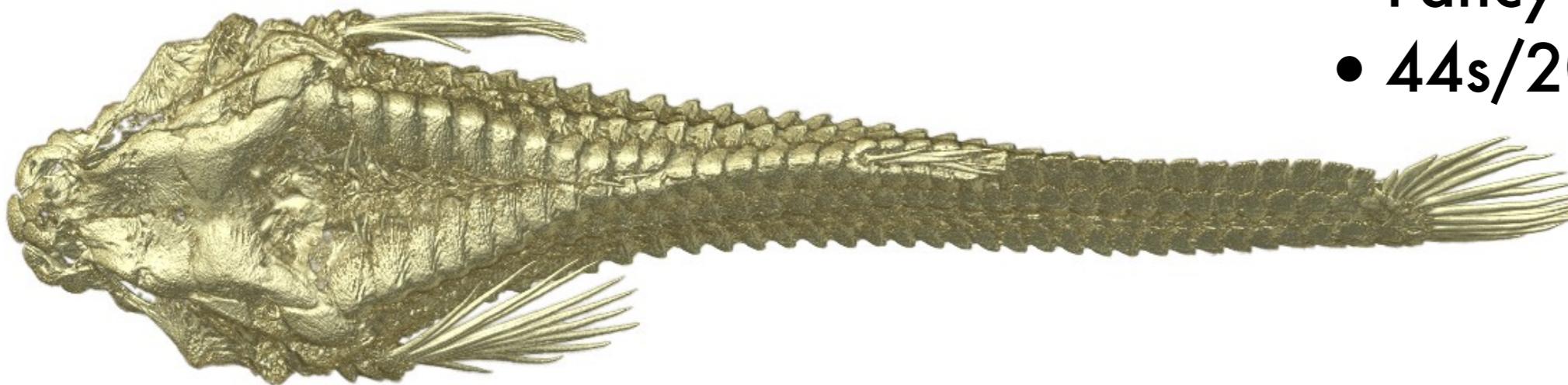
- Agonidae
- Fancy sculpins



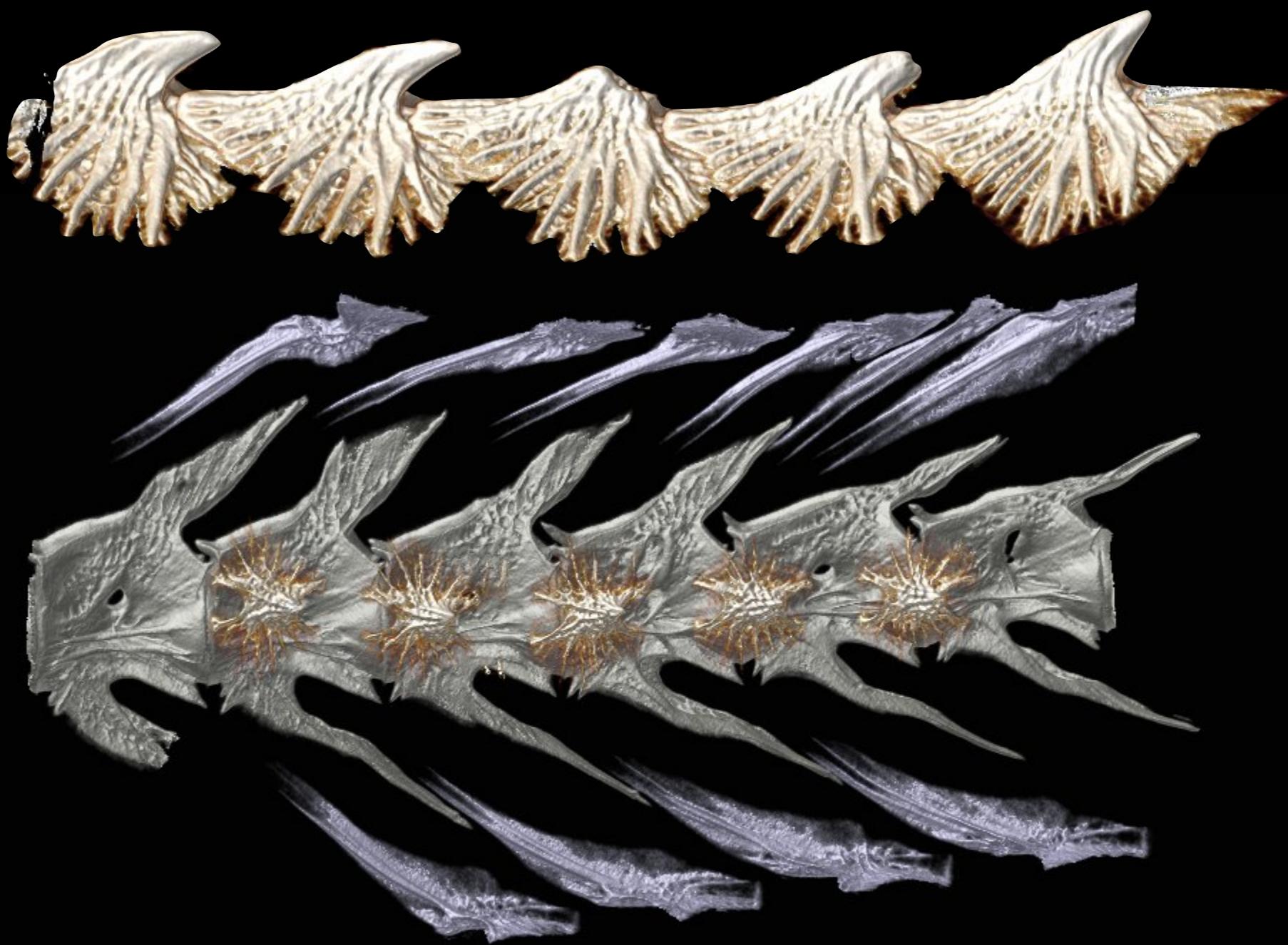
*Bothragonus occidentalis*

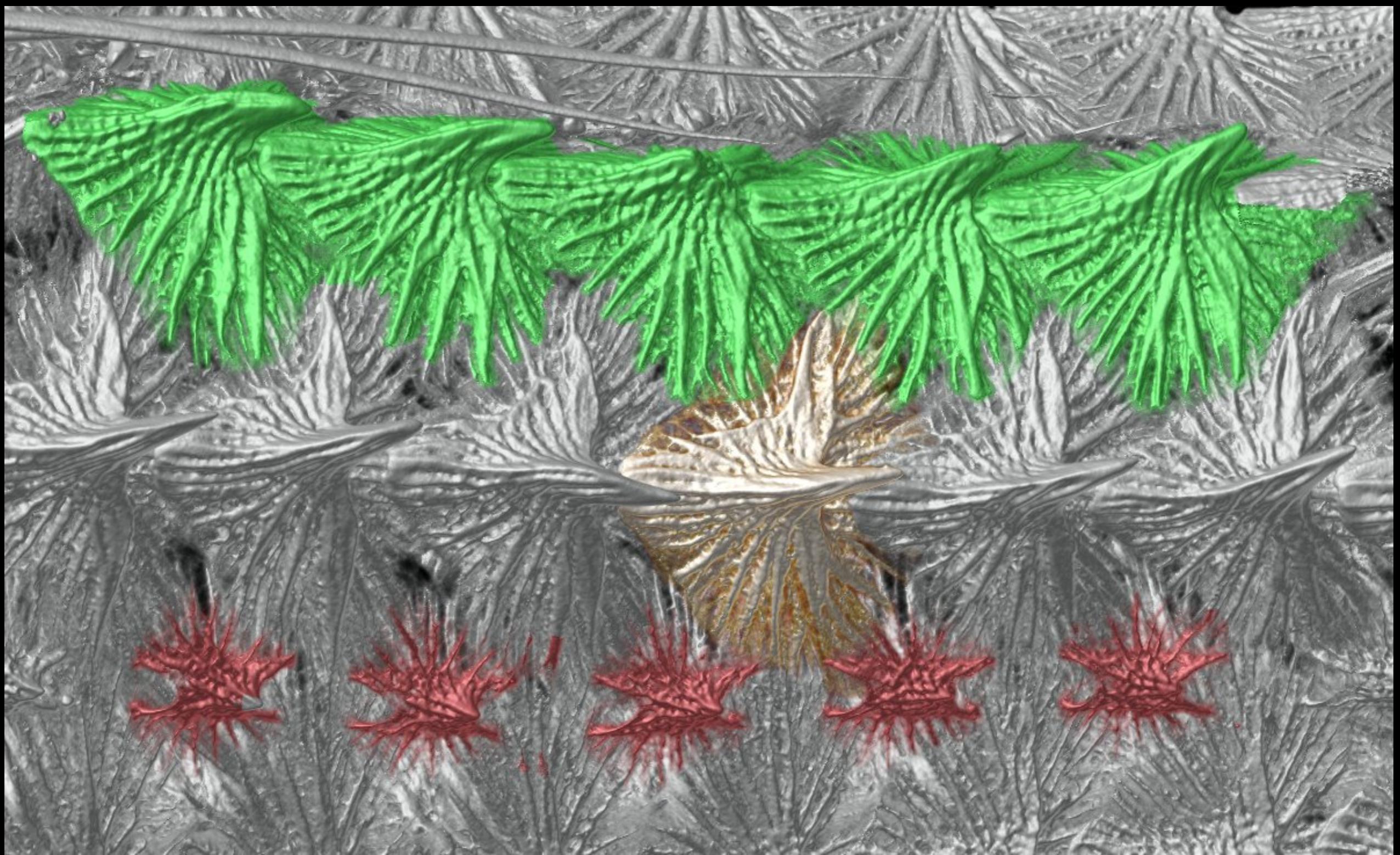
# Poachers.

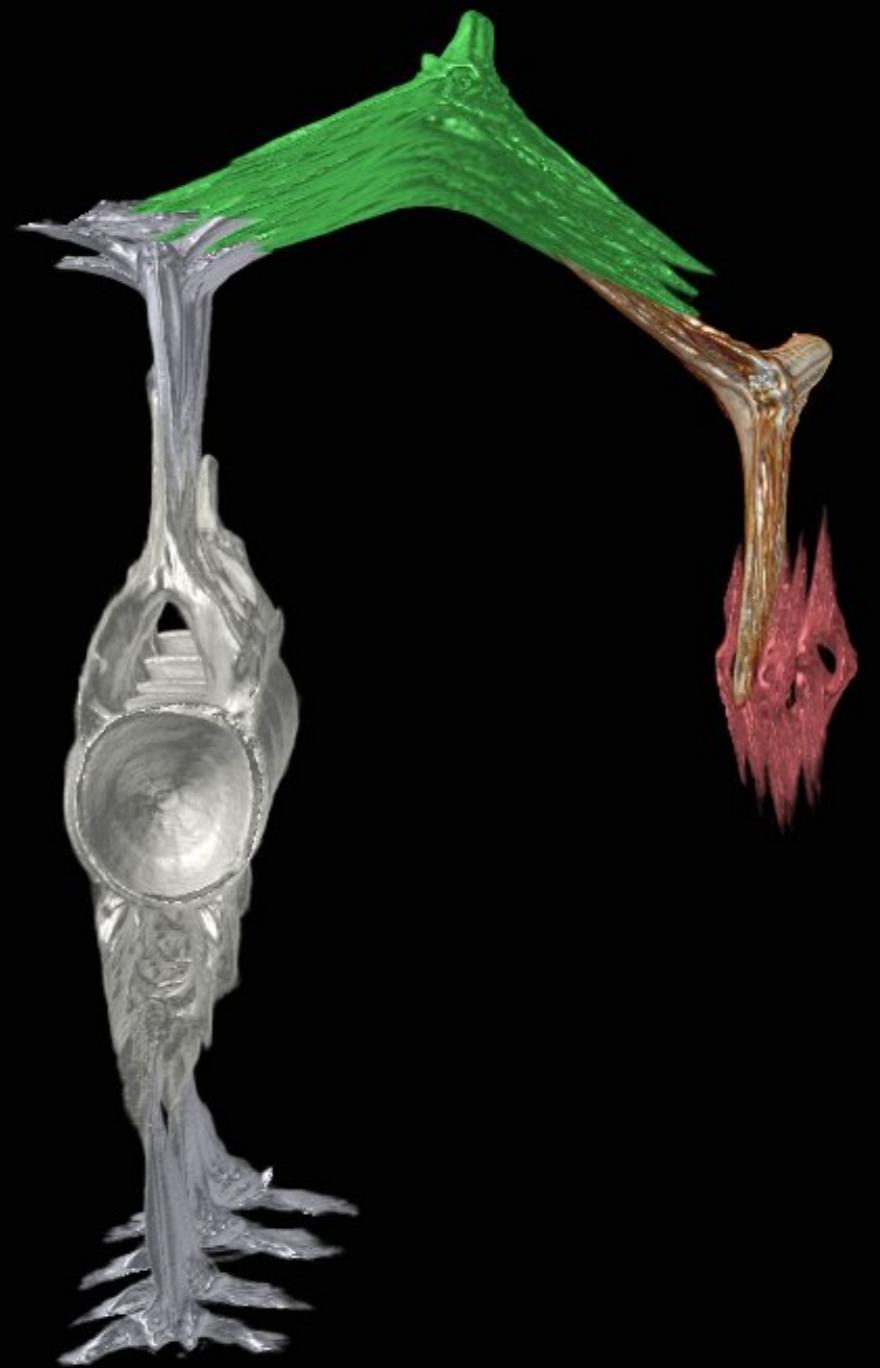
- Agonidae
- Fancy sculpins
- 44s/20g scanned

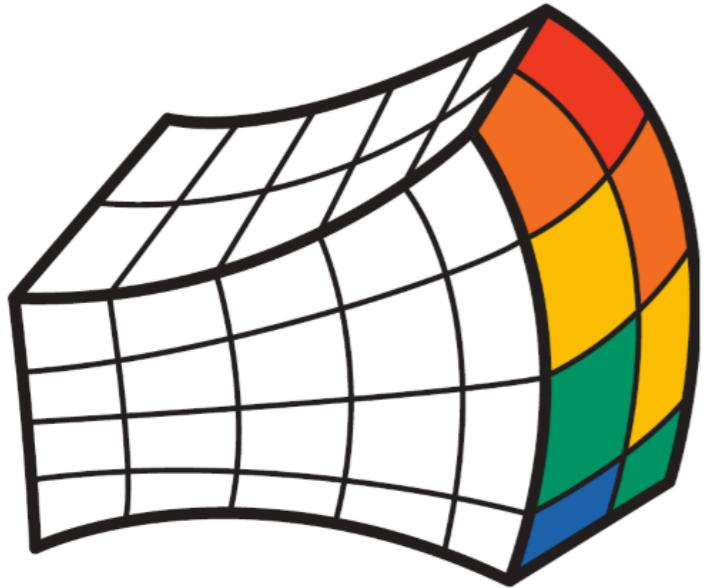


*Bothragonus occidentalis*







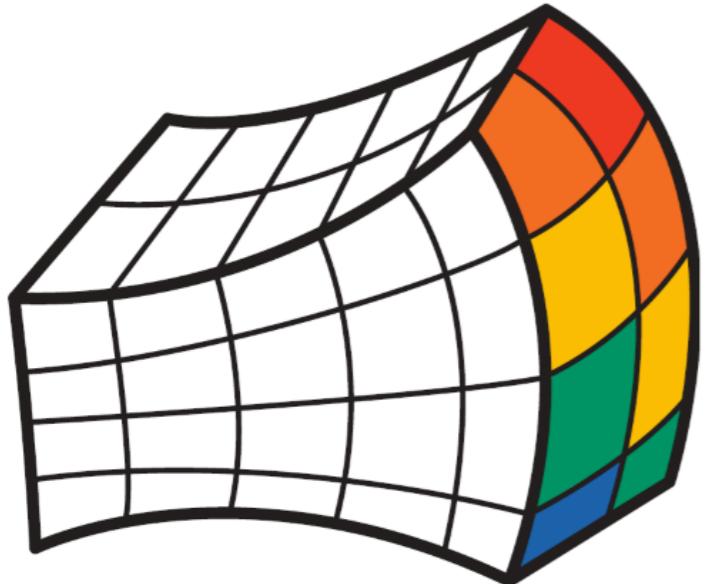


**SLICERMORPH**





- Free, Open Source

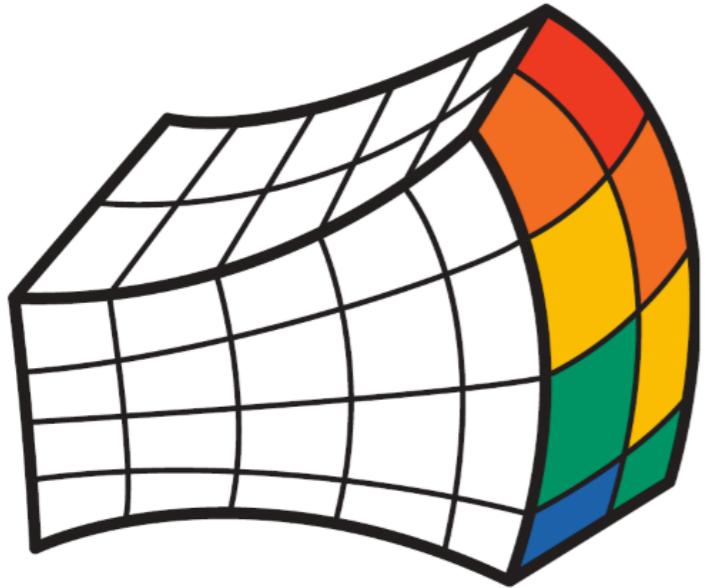


**SLICERMORPH**



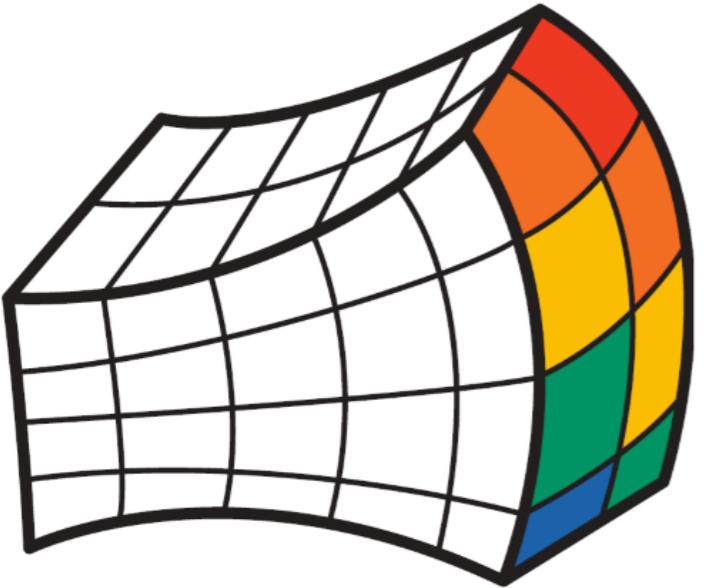


- Free, Open Source
- Tutorials



**SLICERMORPH**

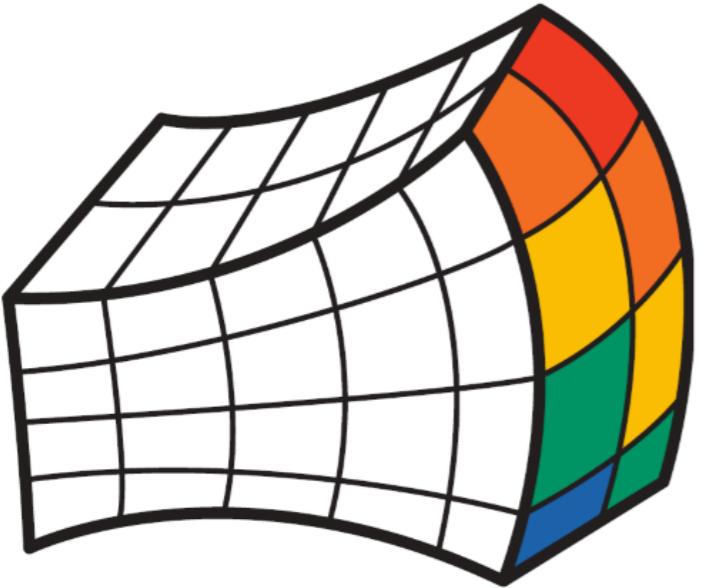




**SLICERMORPH**

- Free, Open Source
- Tutorials
- Rapid feature rollout

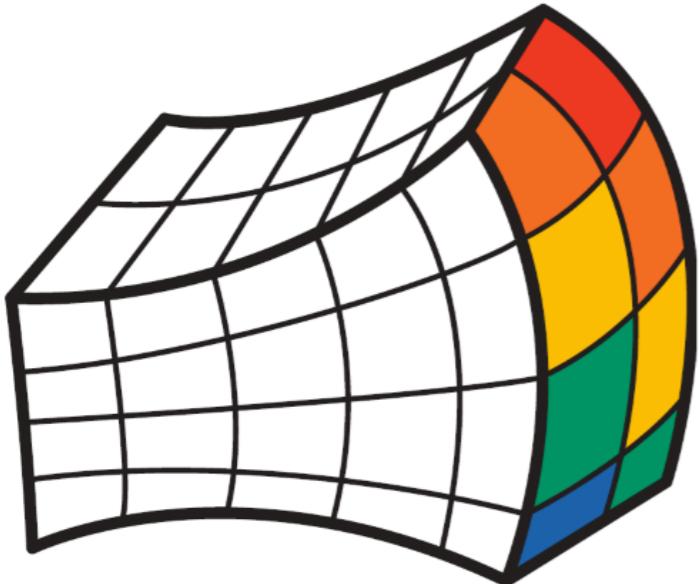




**SLICERMORPH**

- Free, Open Source
- Tutorials
- Rapid feature rollout

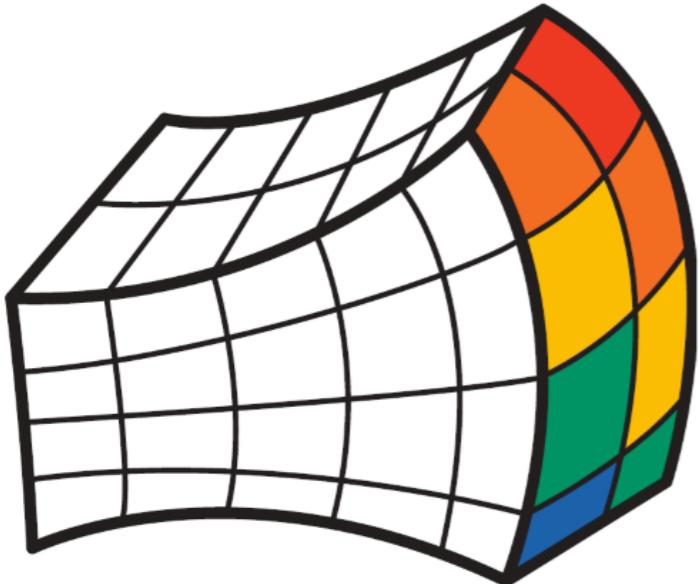




**SLICERMORPH**

- Free, Open Source
- Tutorials
- Rapid feature rollout
- Segment axial skeleton

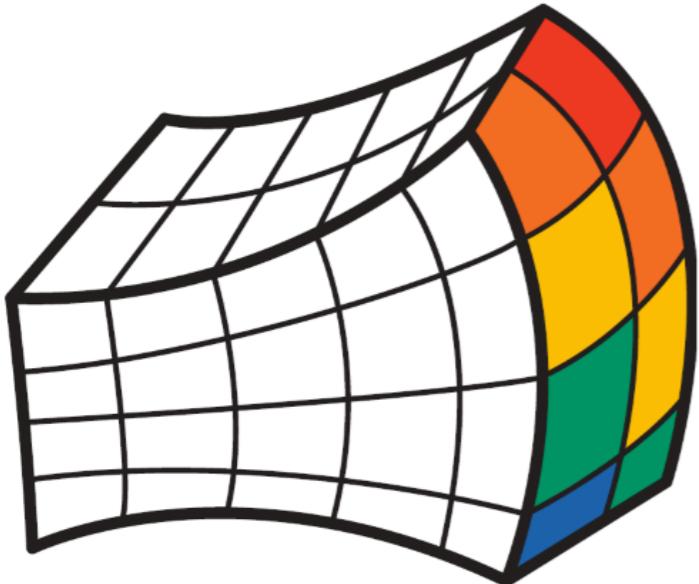




**SLICERMORPH**

- Free, Open Source
- Tutorials
- Rapid feature rollout
- Segment axial skeleton
- Segment armor

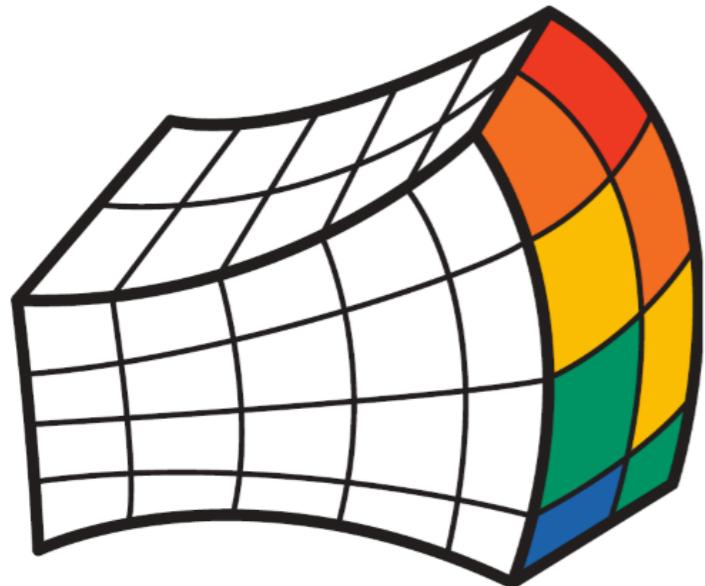




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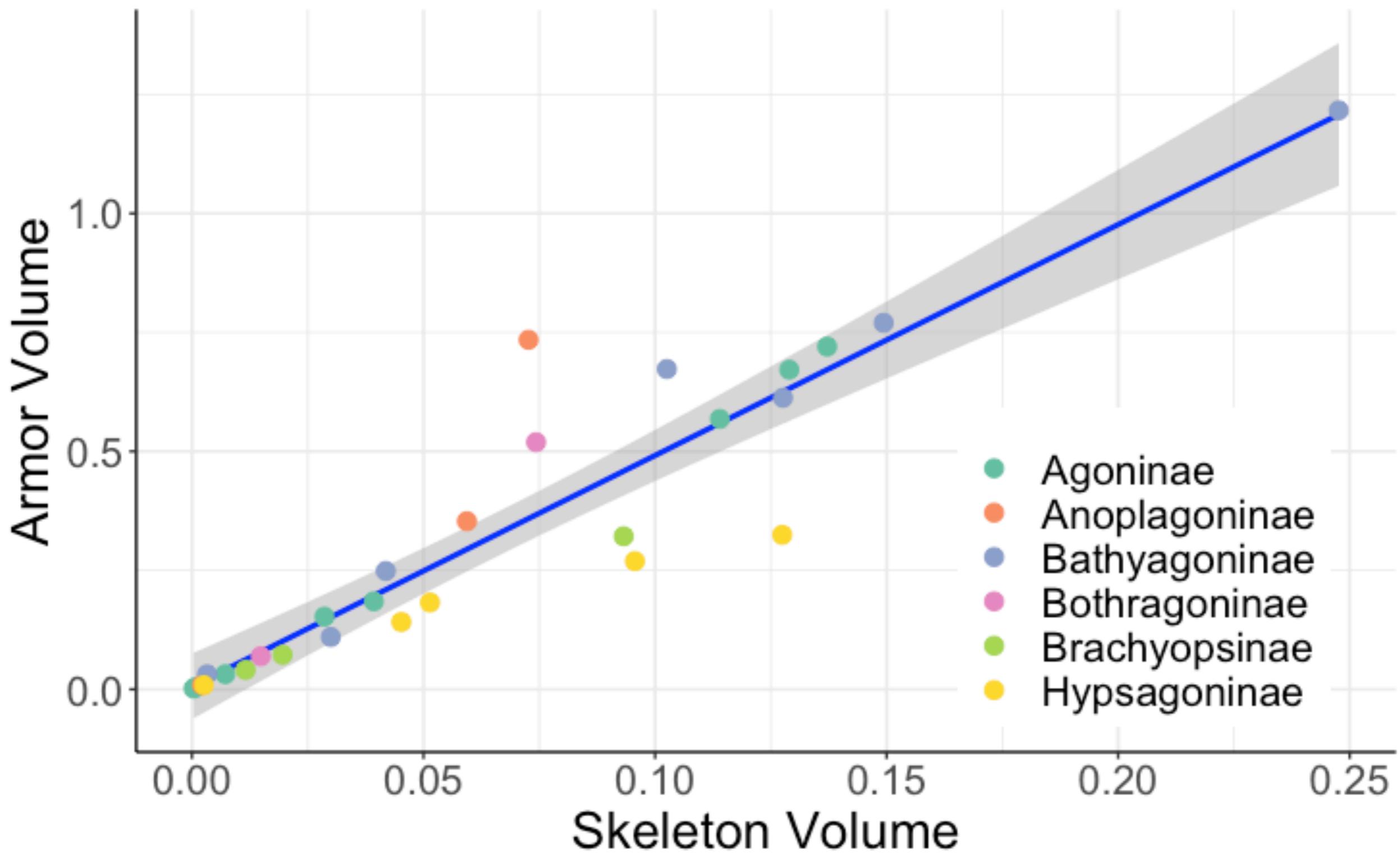
- Free, Open Source
- Tutorials
- Rapid feature rollout
- Segment axial skeleton
- Segment armor

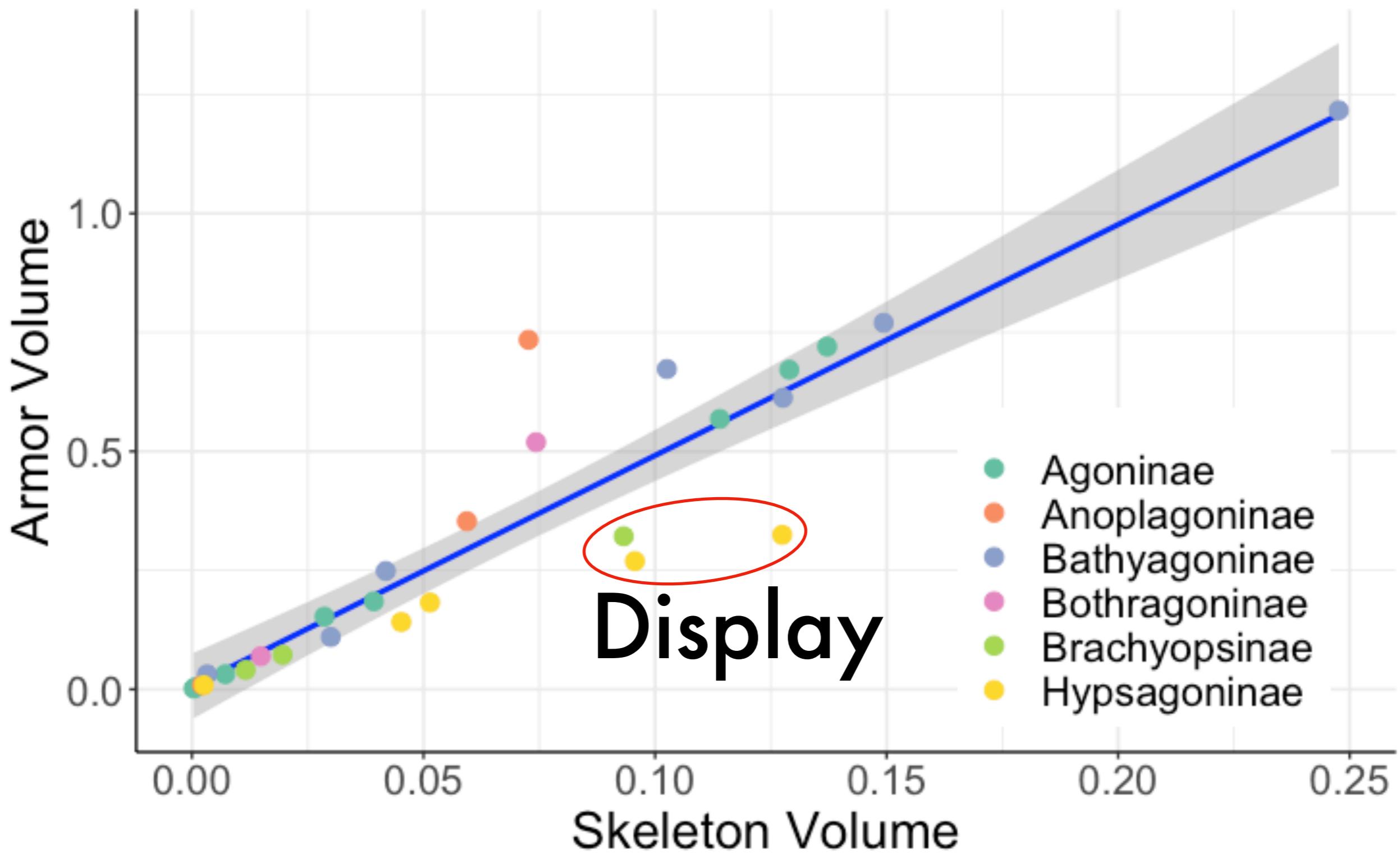


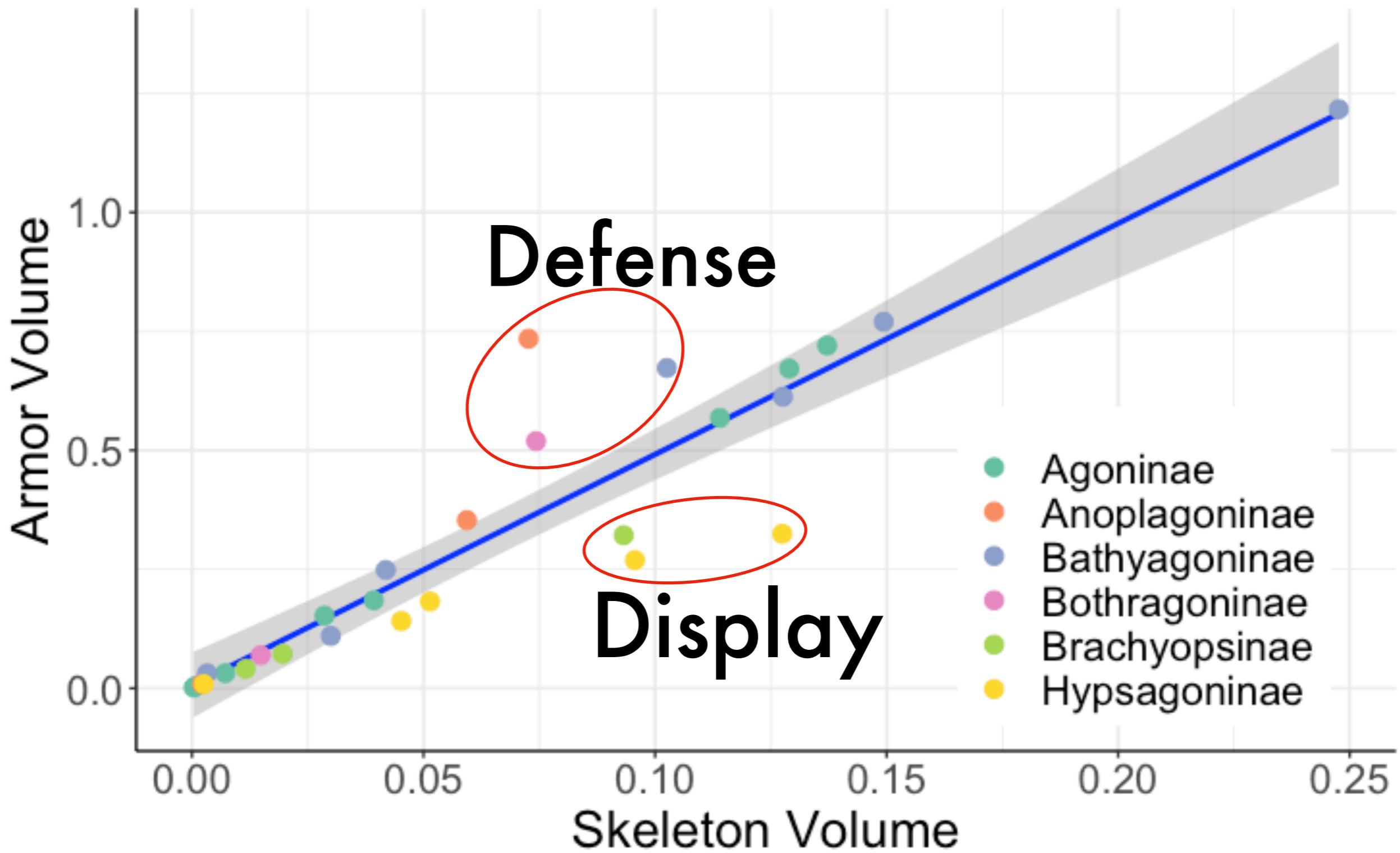


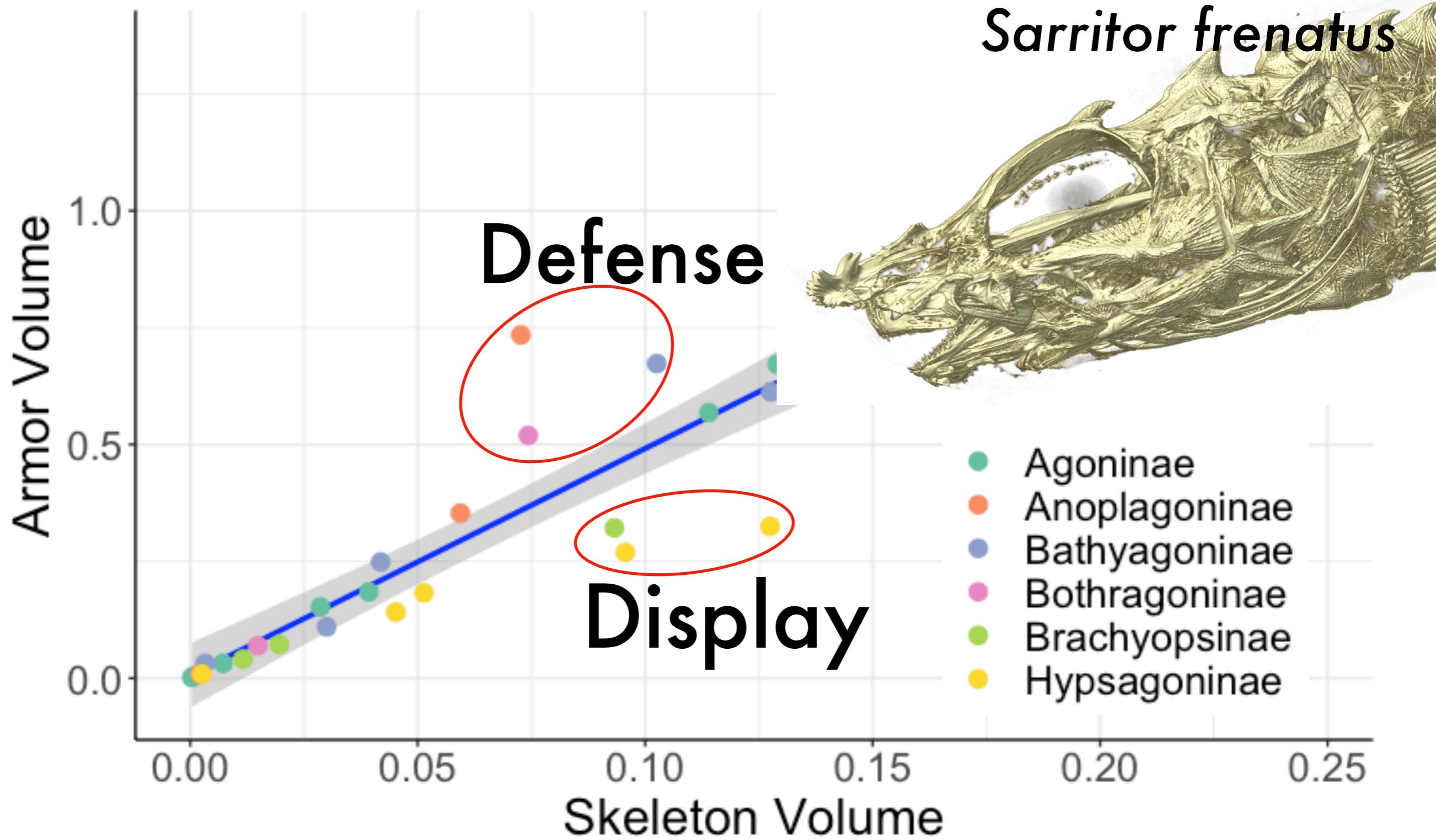
- Free, Open Source
- Tutorials
- Rapid feature rollout
- Segment axial skeleton
- Segment armor
- 28 species

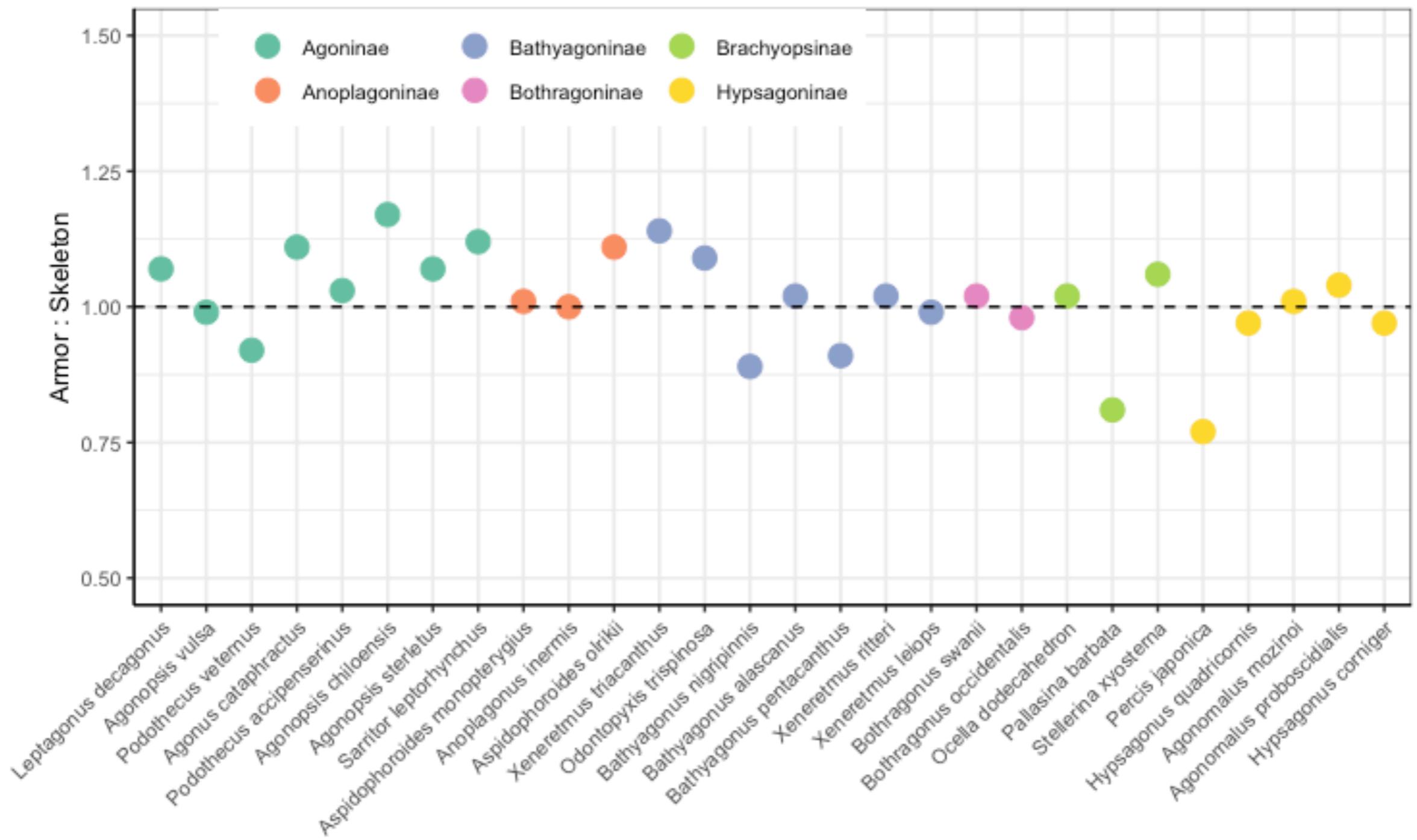


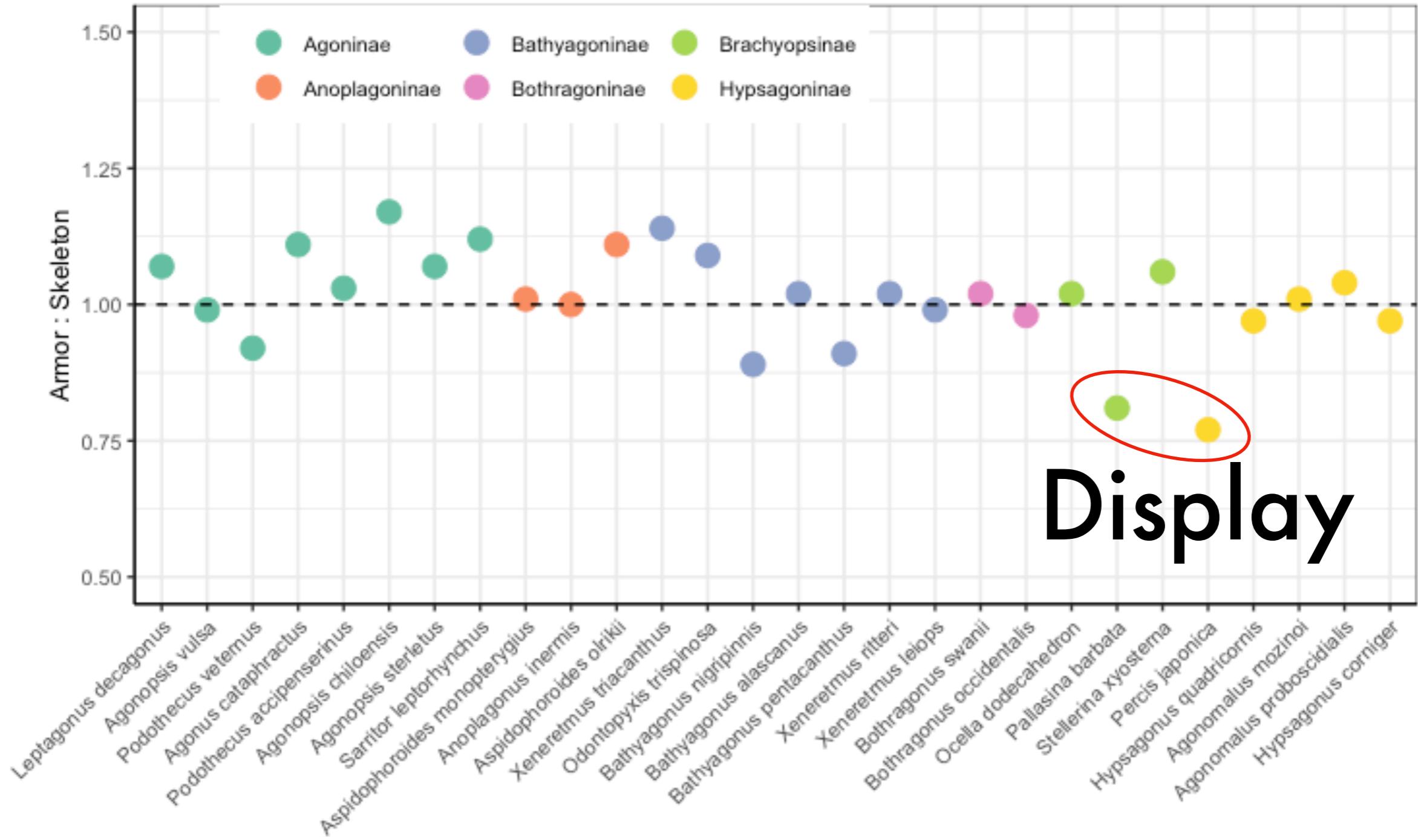


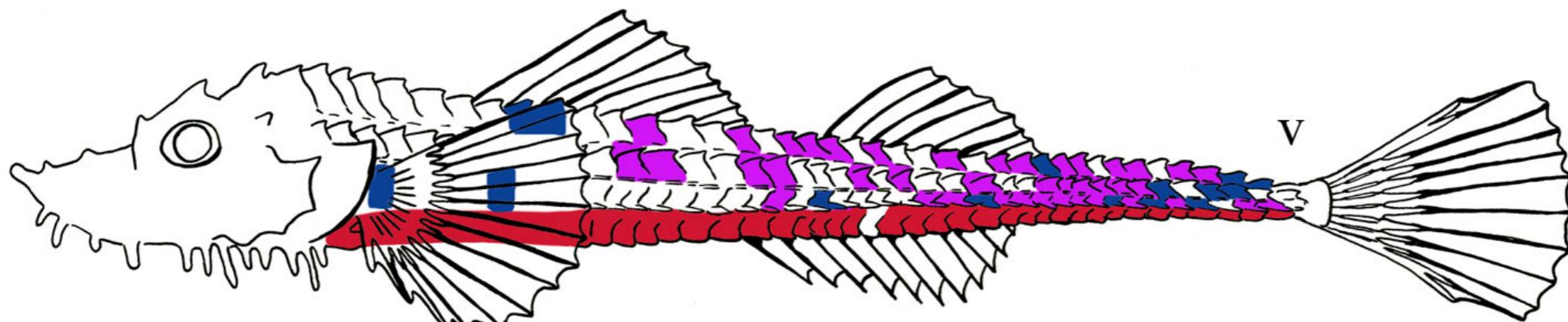








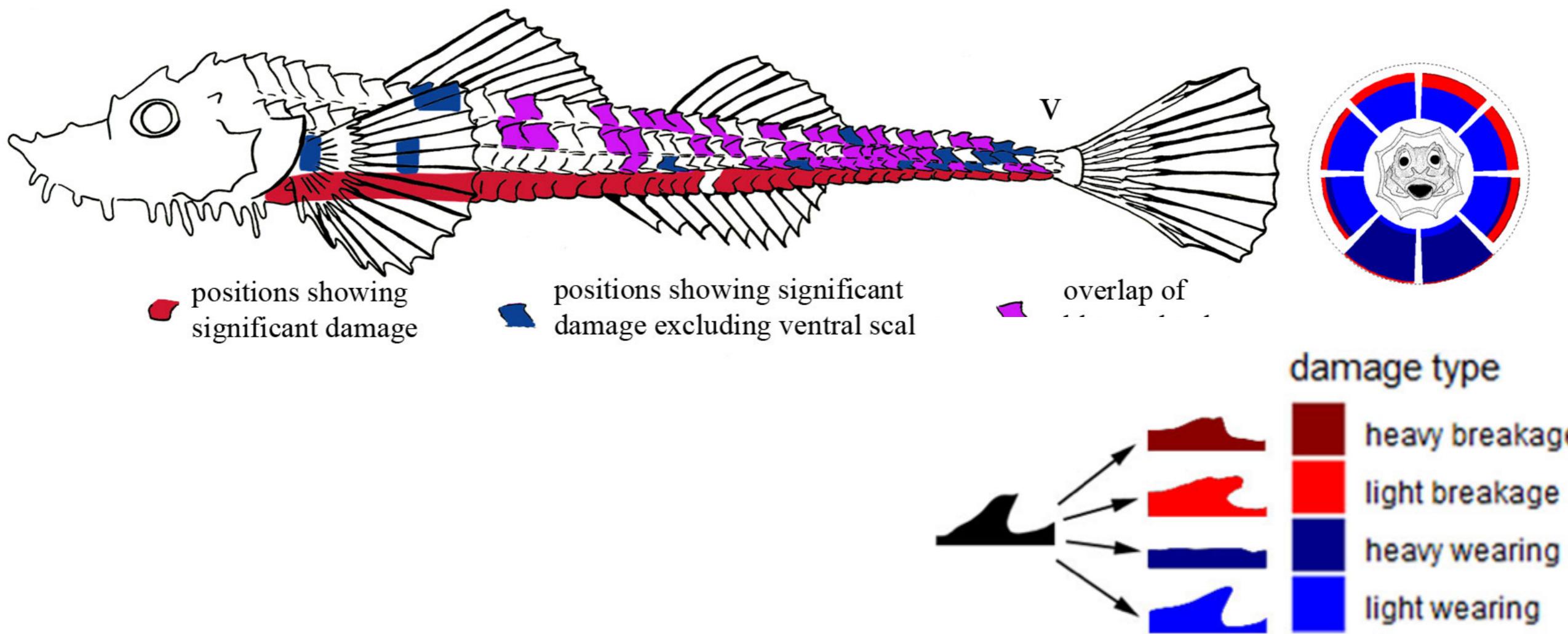


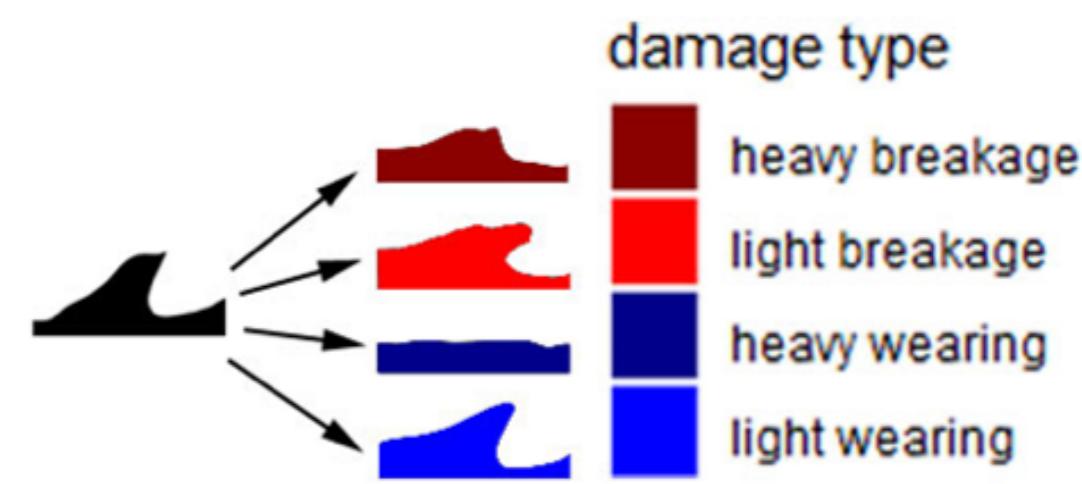
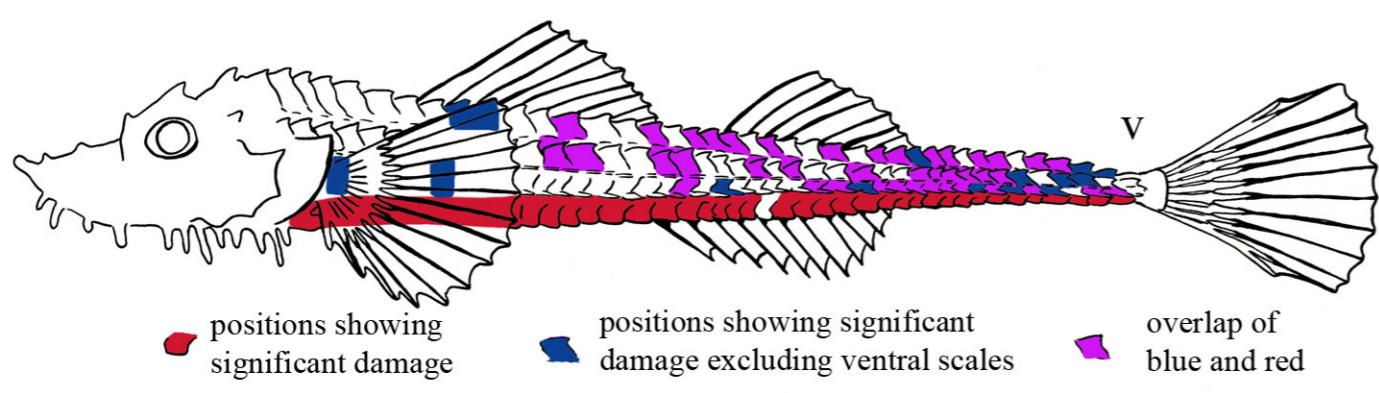


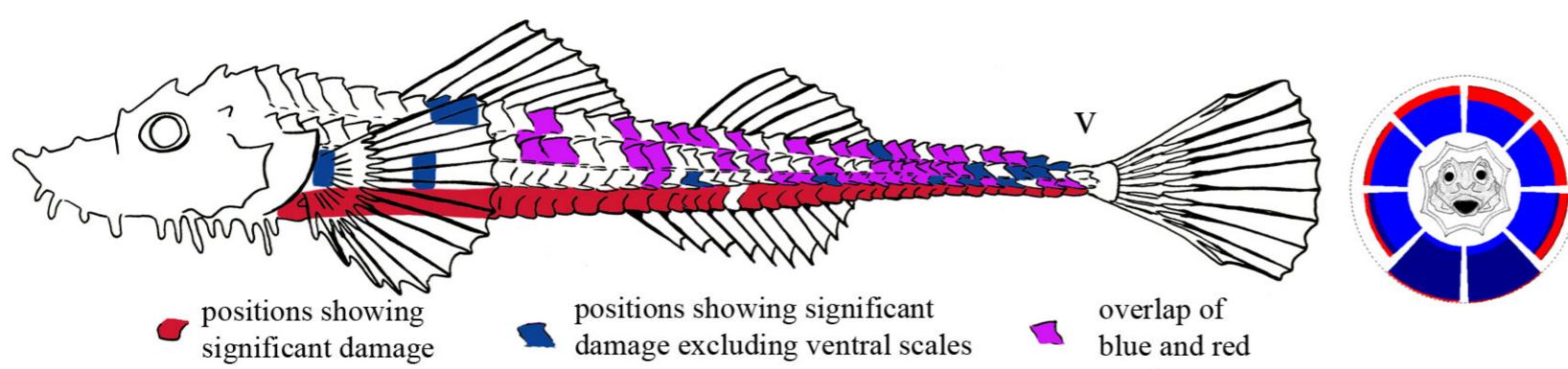
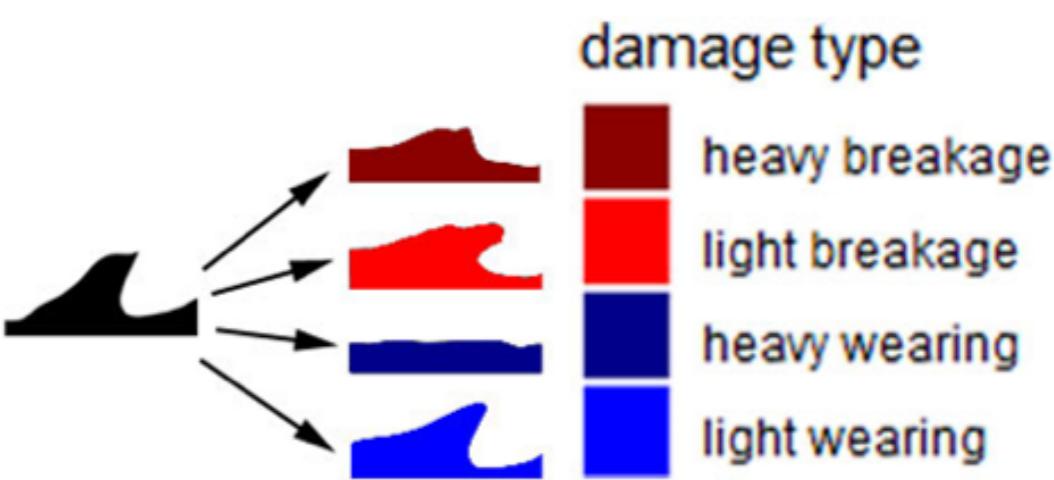
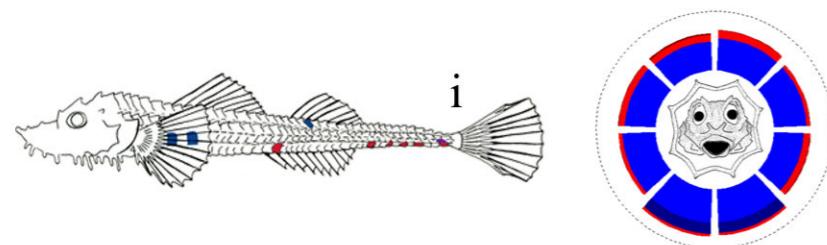
positions showing  
significant damage

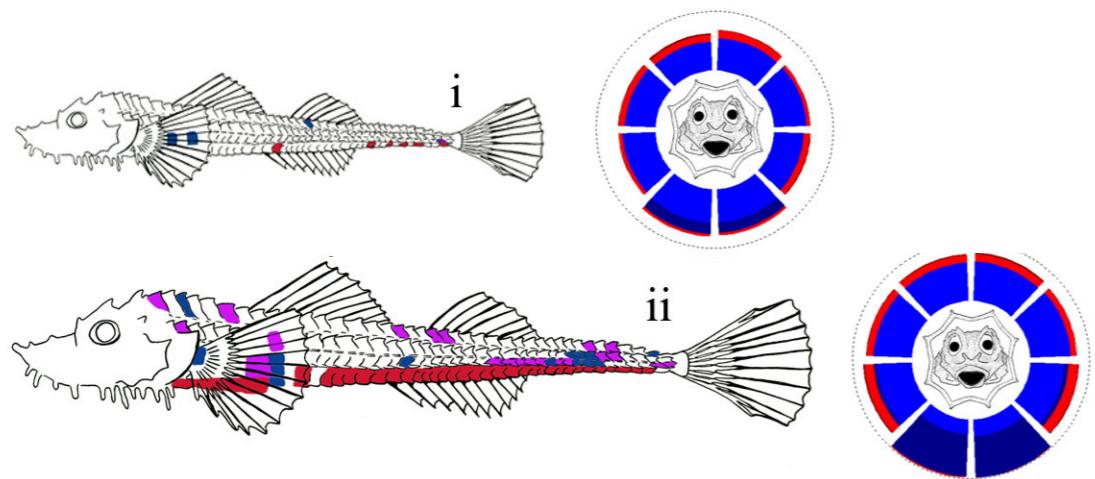
positions showing significant  
damage excluding ventral scales

overlap of  
blue and red

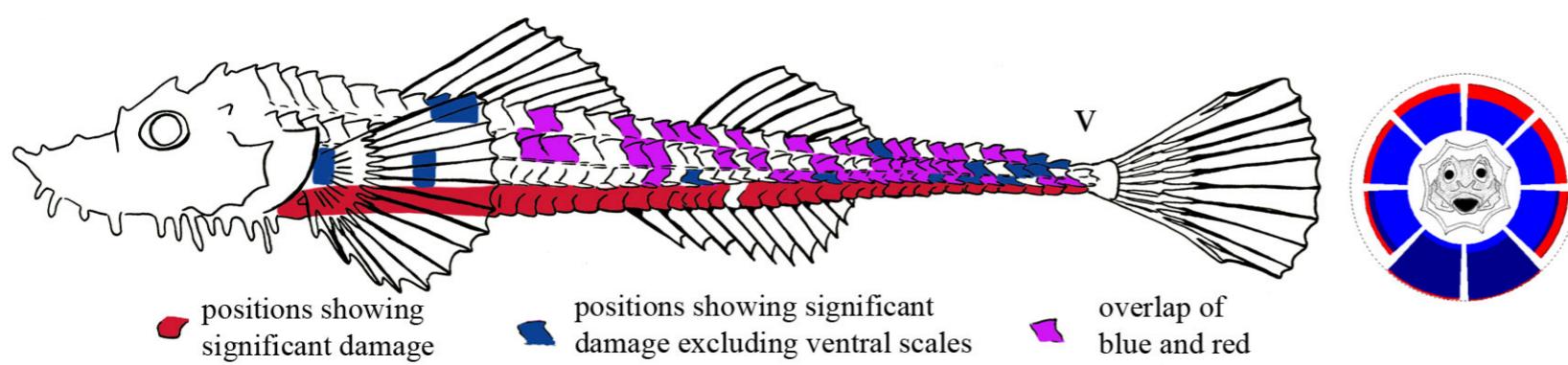
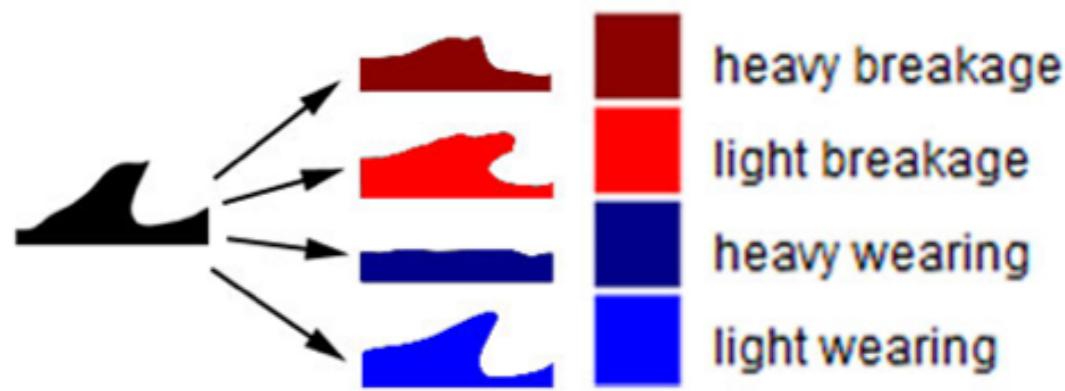


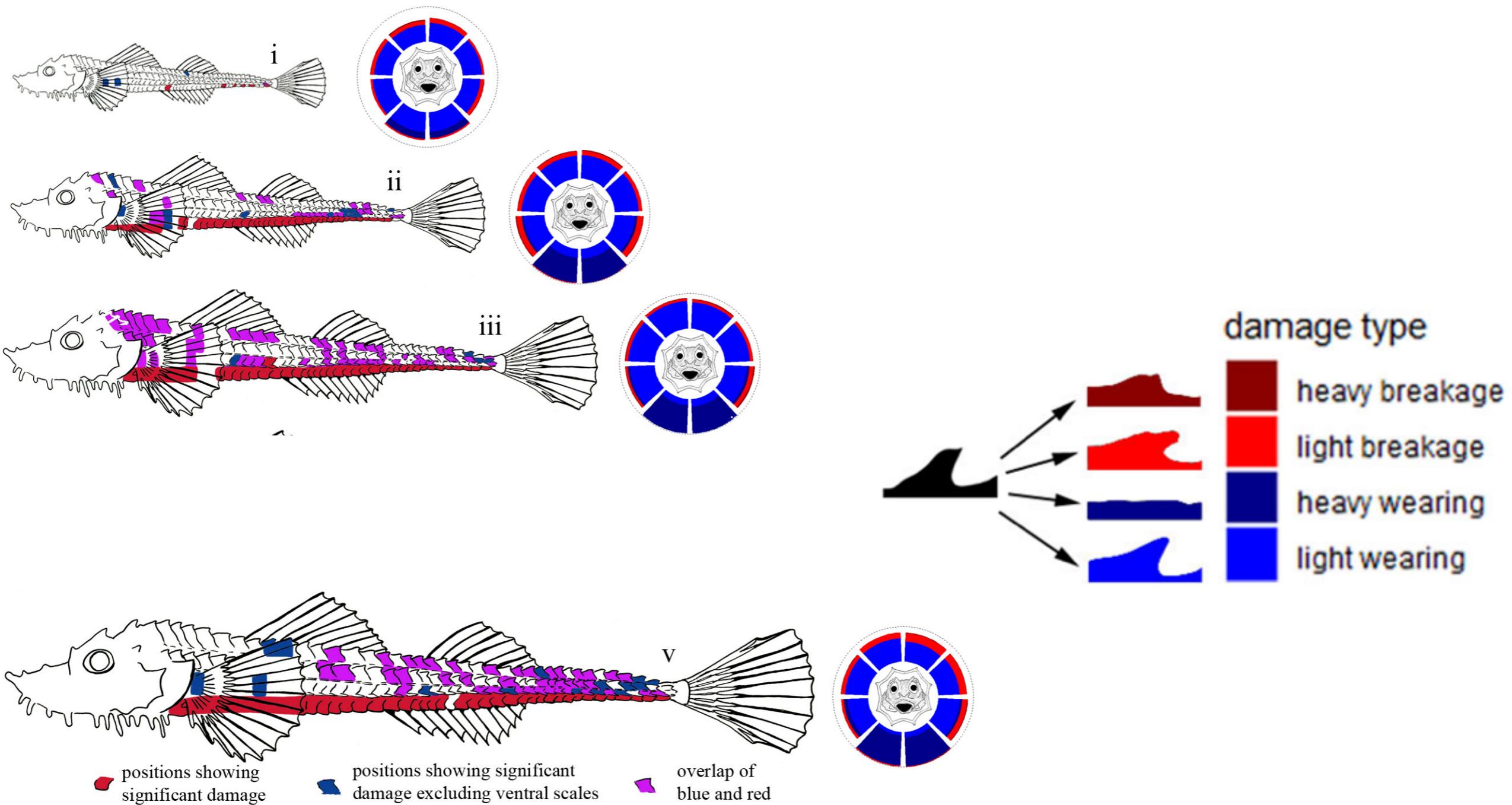


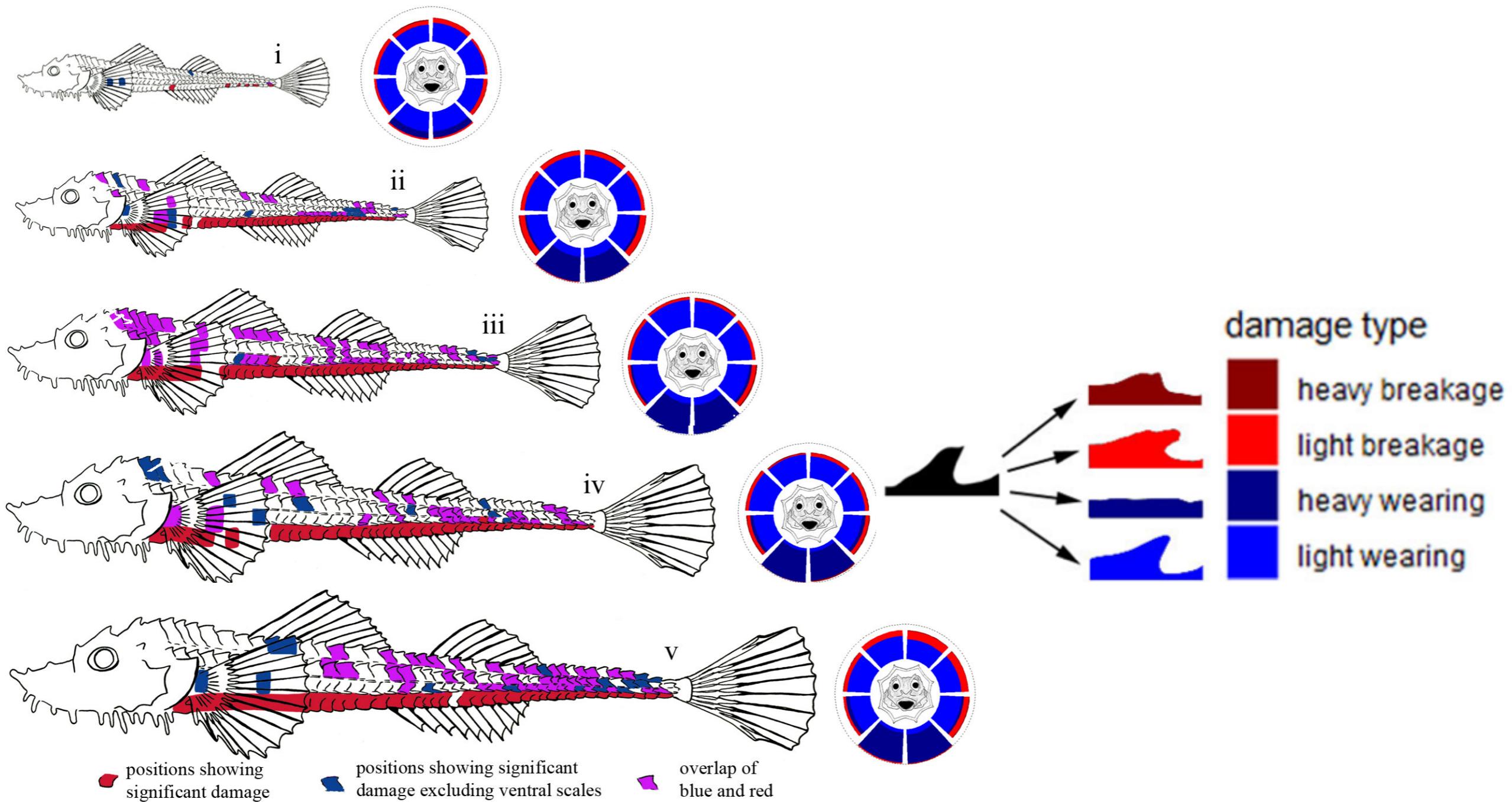




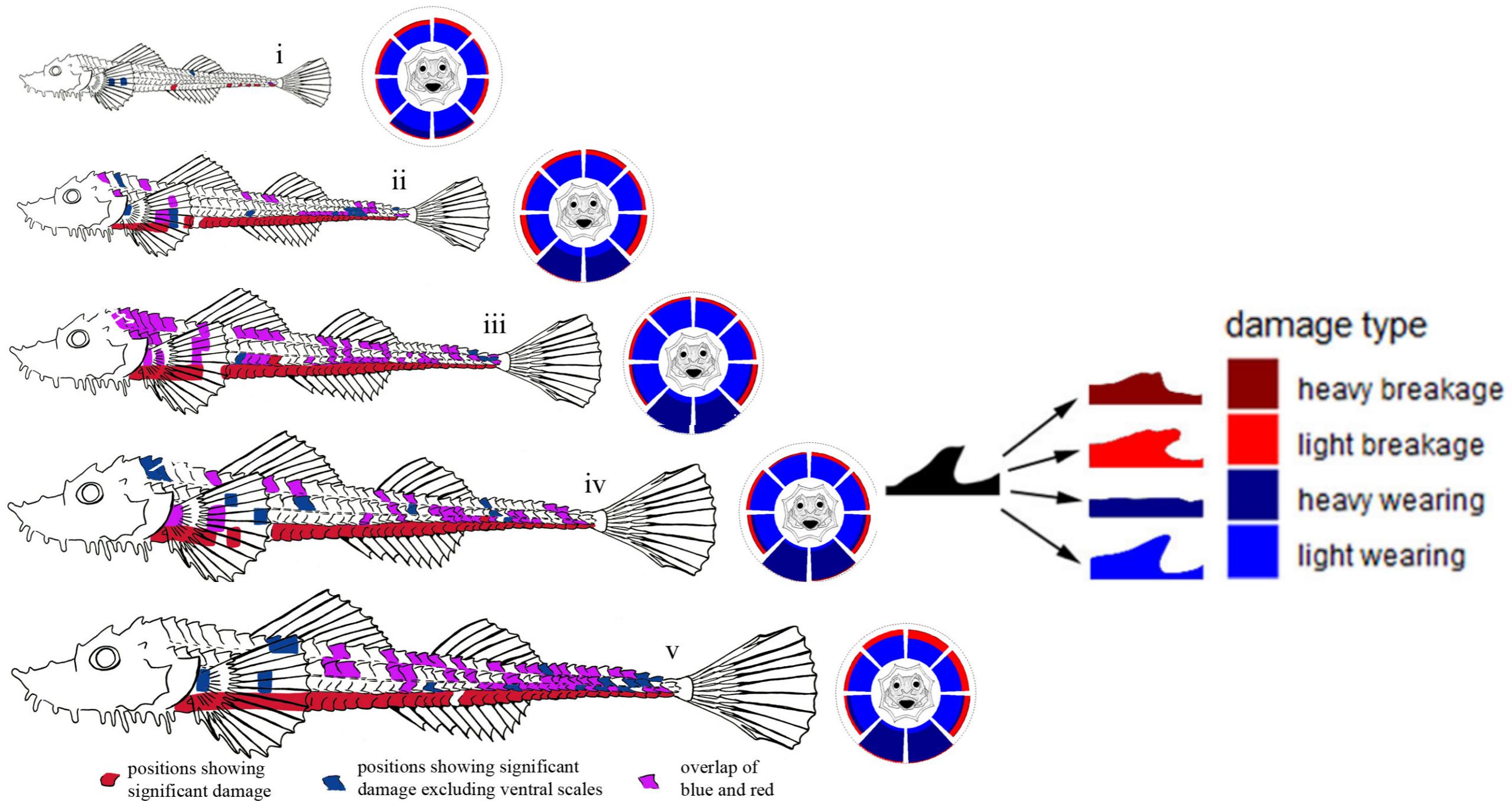
### damage type



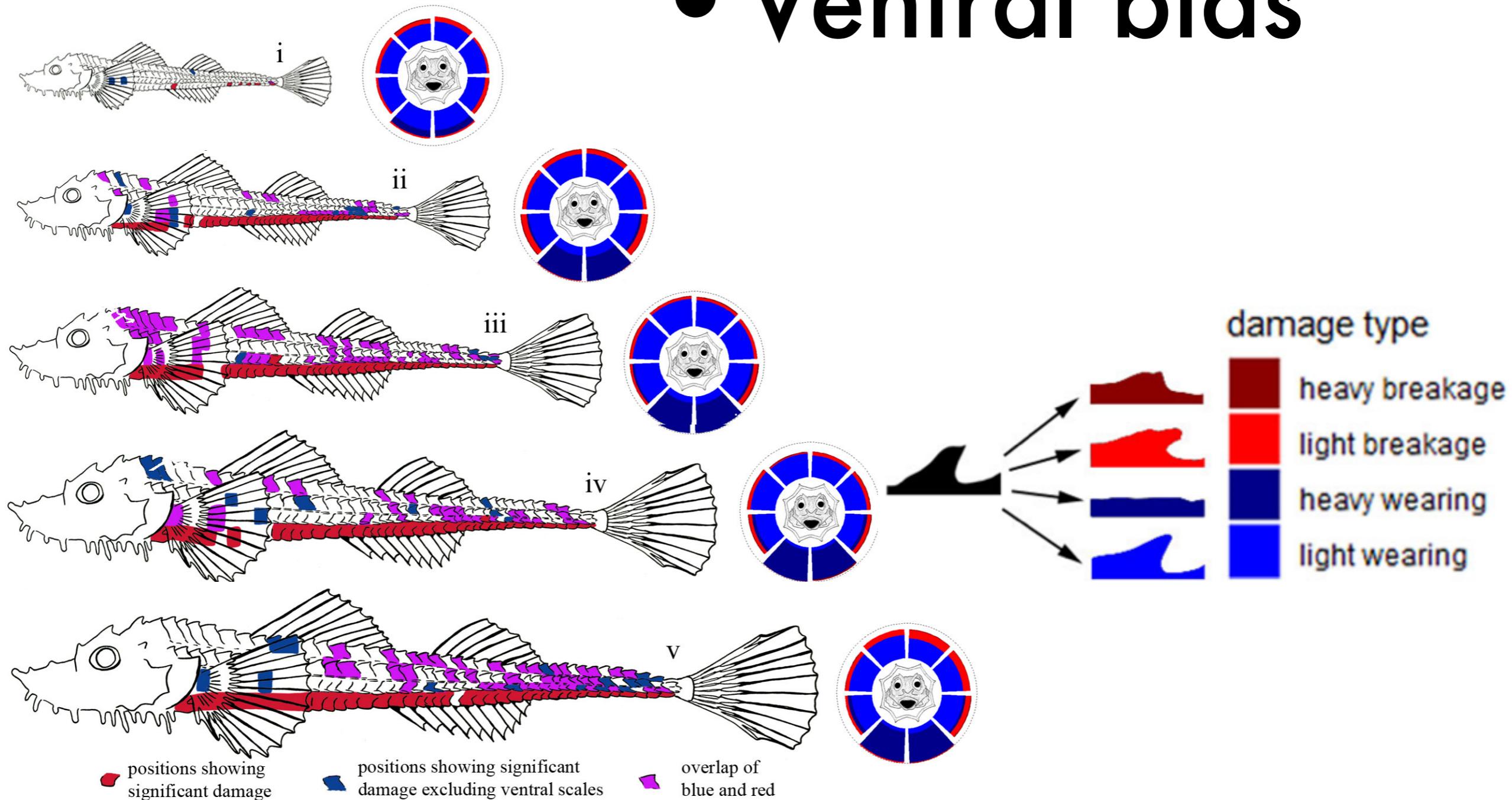




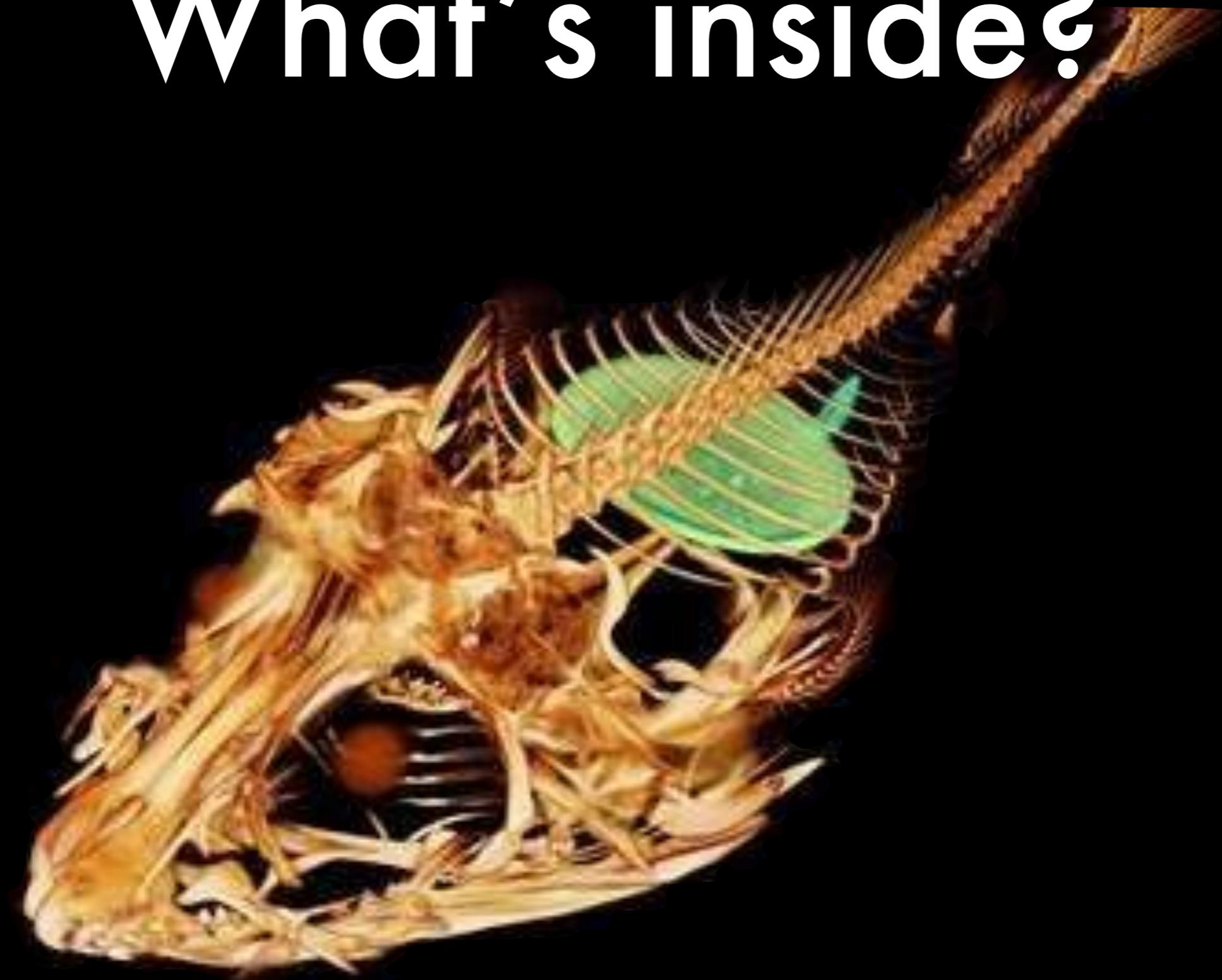
# • L-R asymmetry

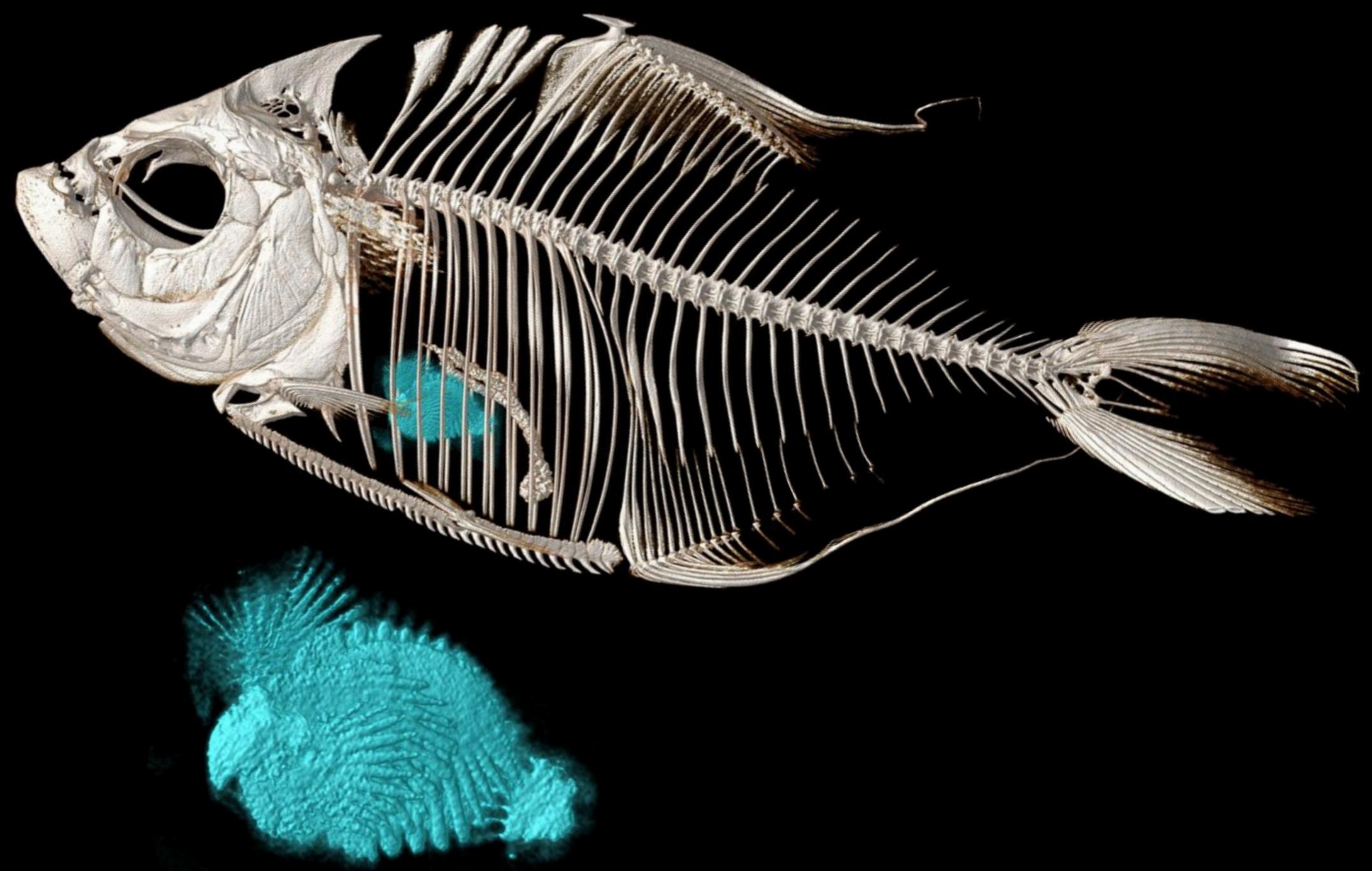


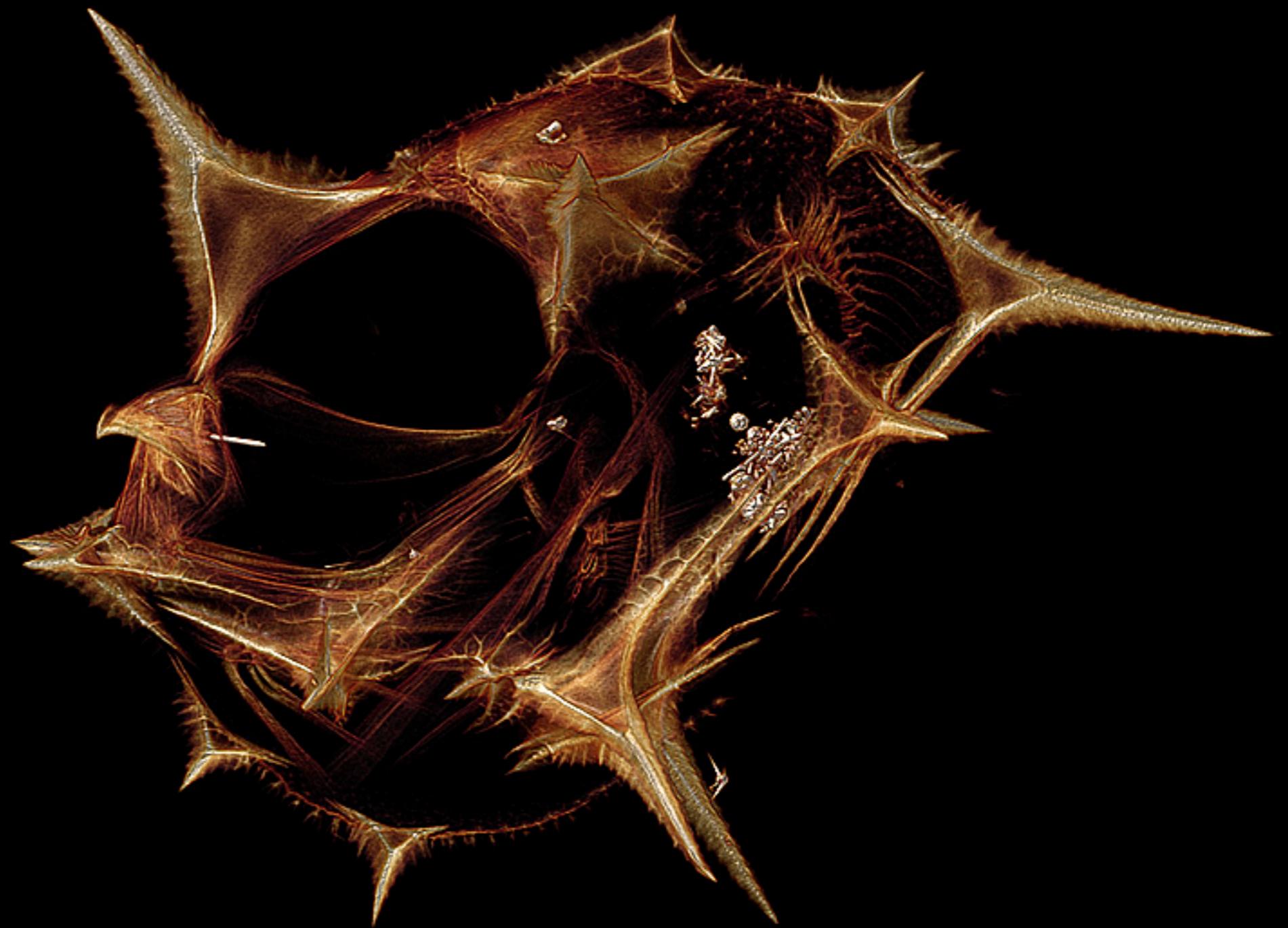
- L-R asymmetry
- Ventral bias



# What's inside?





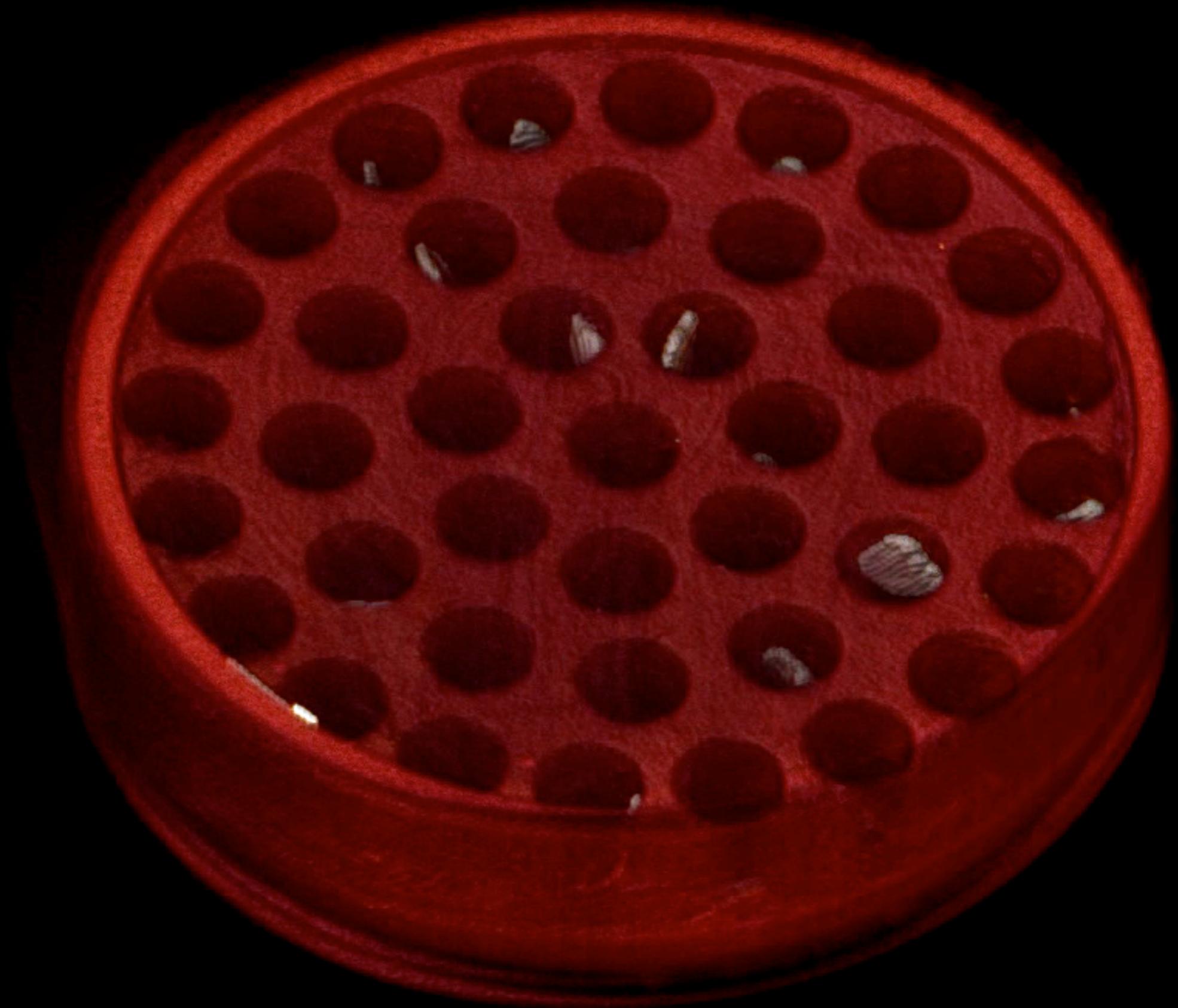


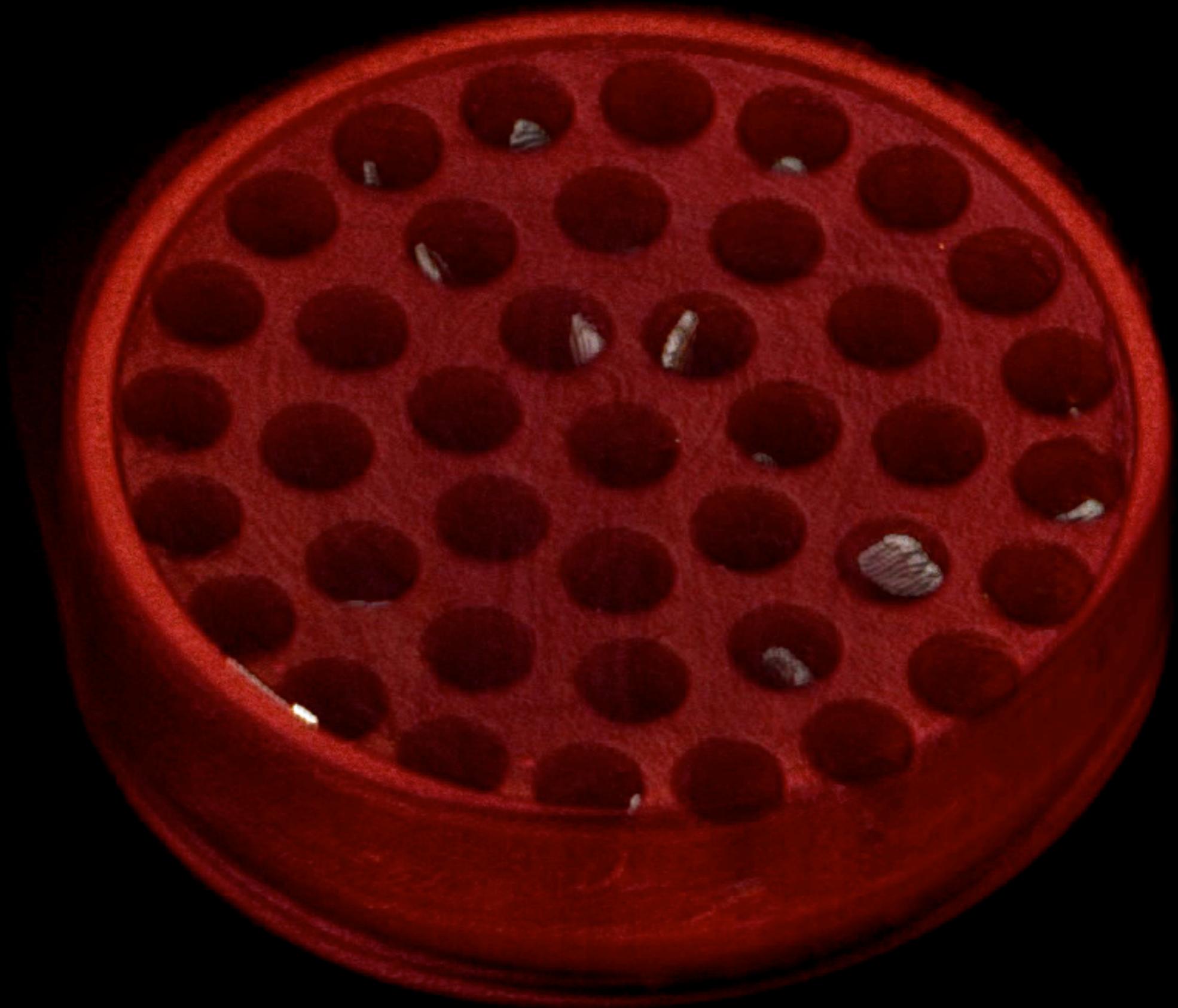
# Non-rigid Transforms

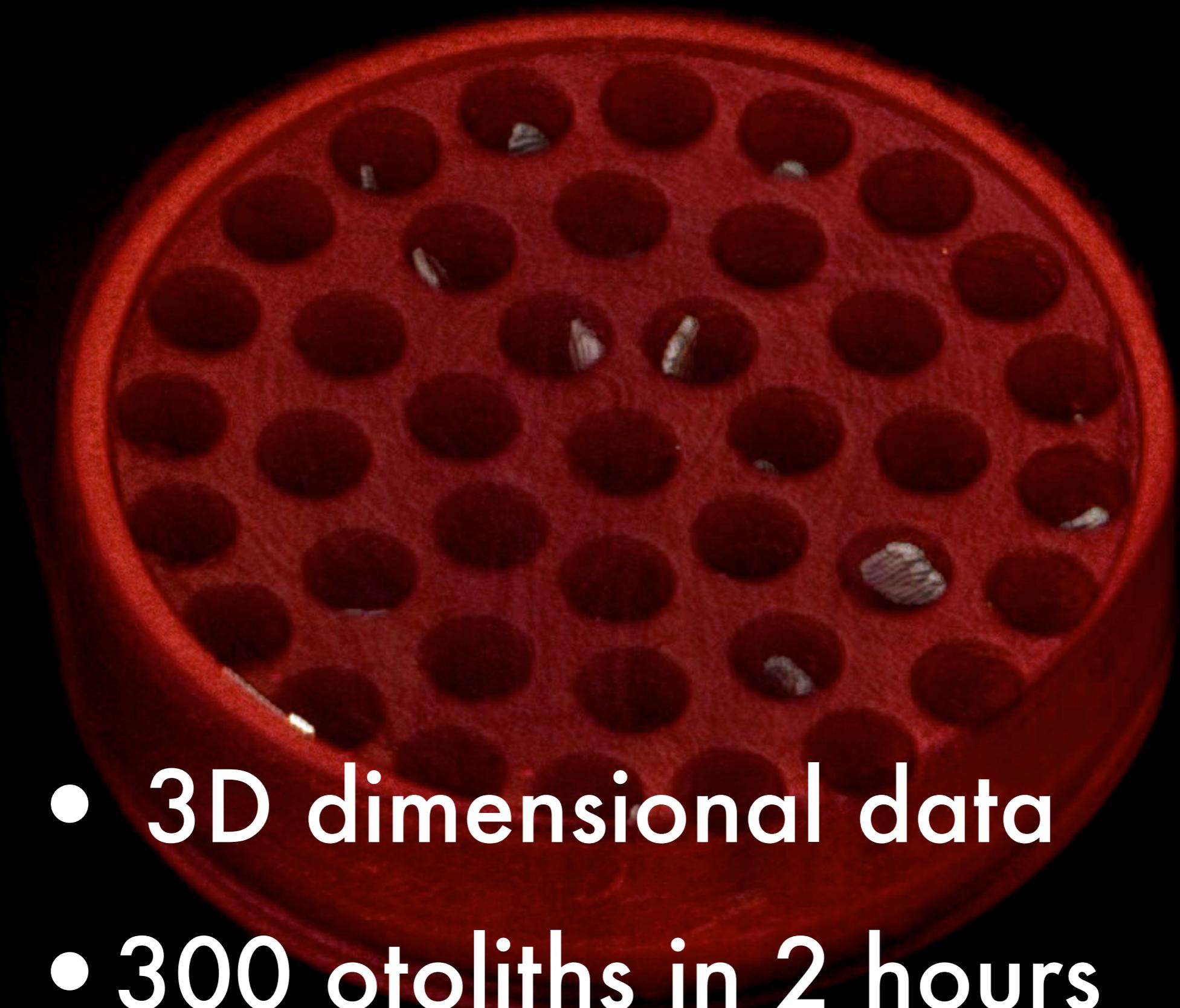
# Show Video

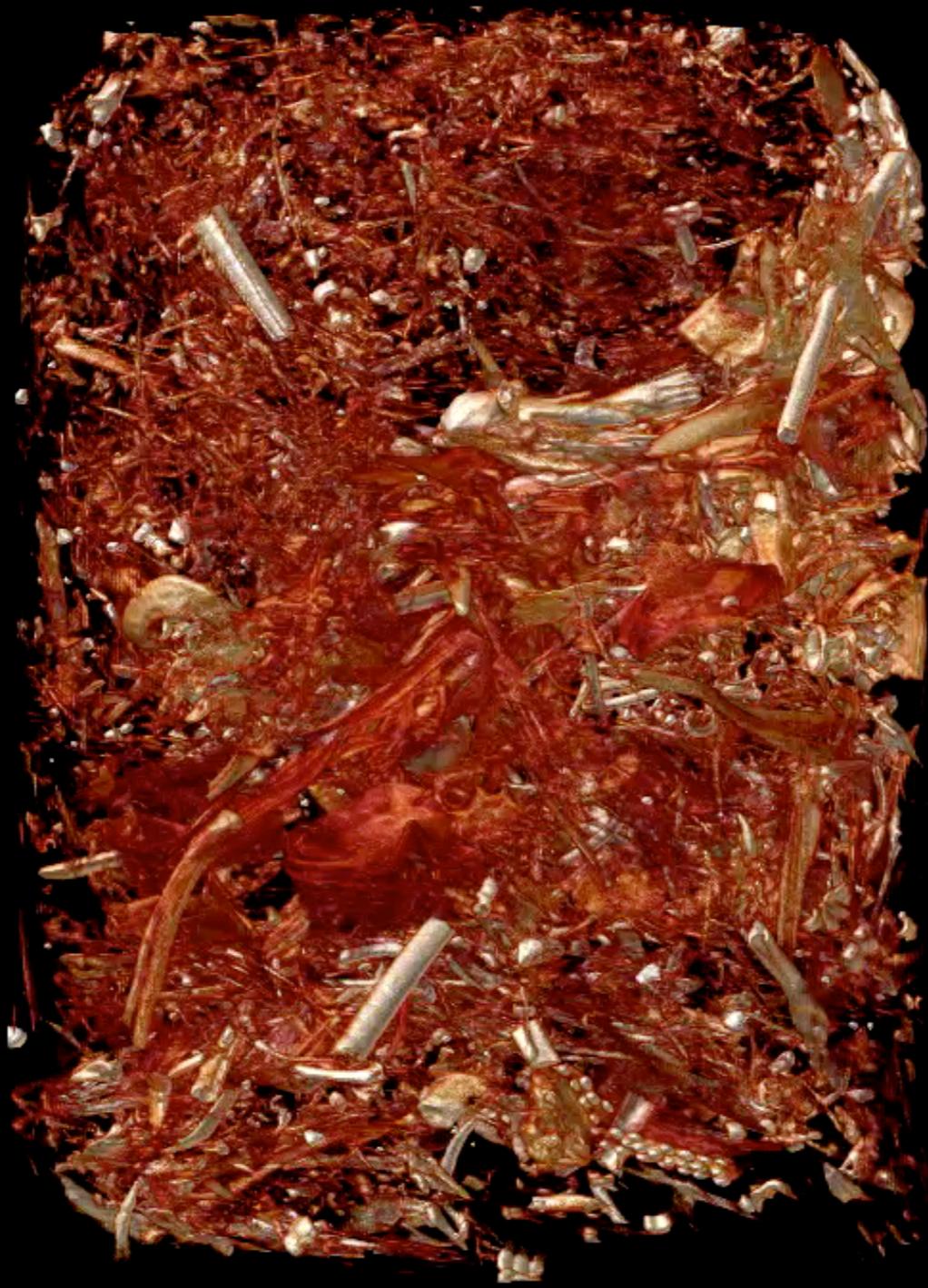
Everyone likes a video

# Magic

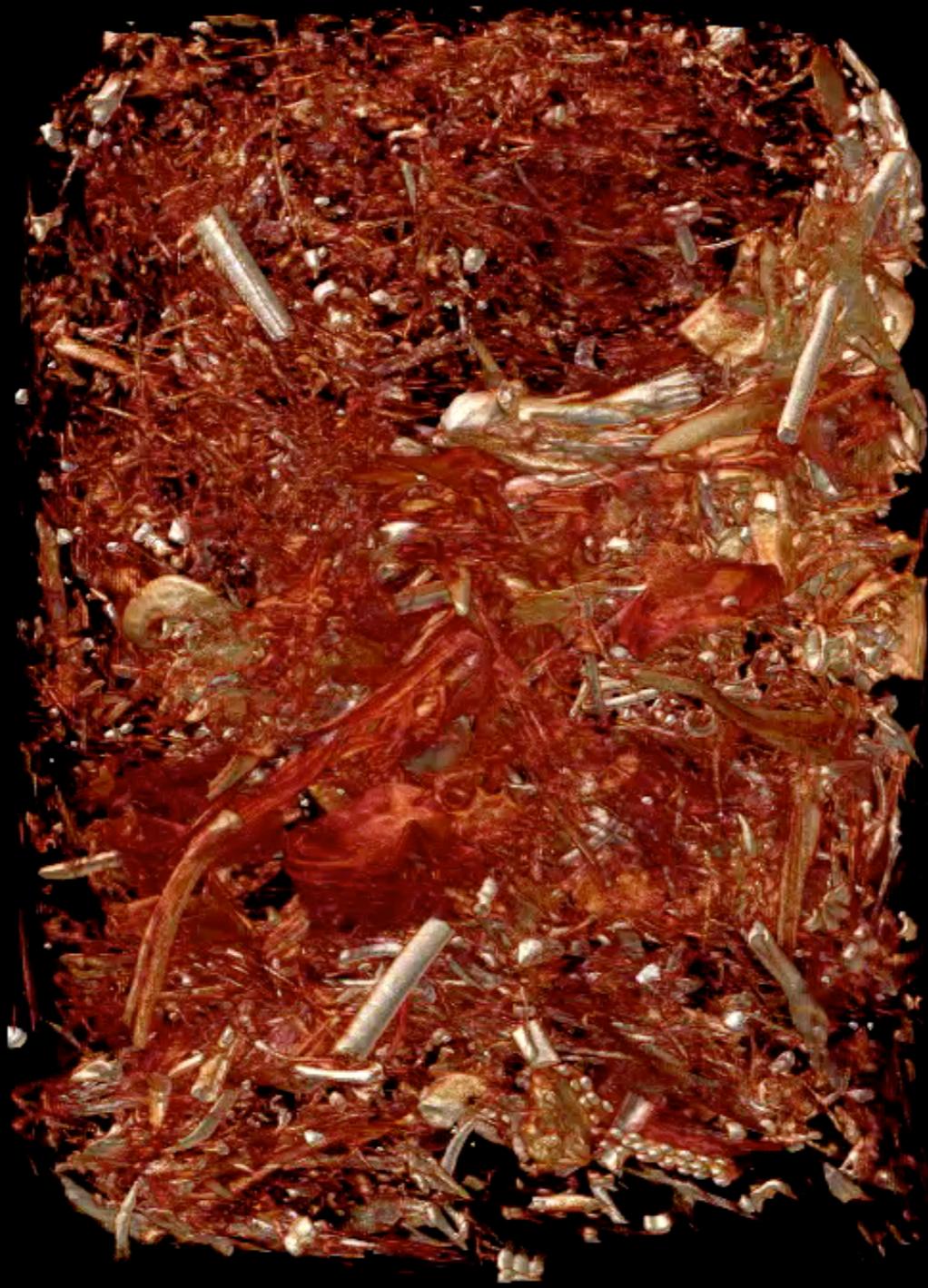




- 
- 3D dimensional data
  - 300 otoliths in 2 hours



•Scat scan



•Scat scan



Stephanie Crofts



Sebastian Kruppert



Petra Ditsche



Paulina Urban



Morgan Stewart



Misty Paig-Tran



Matt Kolmann



Mackenzie Gerringer



Jules Chabain



Marianne Porter



Thaddaeus Buser



Cassandra Donatelli



Kayla Hall



Karly Cohen



Kory Evans

# Thanks...

