Monitor/Mosasaur Anatomy

Review of swimming mechanics
In Mosasaurs (new anatomical interpretation)

Comparative morphometrics of
The monitor vertebral column

Evolutionary morphometrics of the
Dorsal vertebrae in *Varanus*

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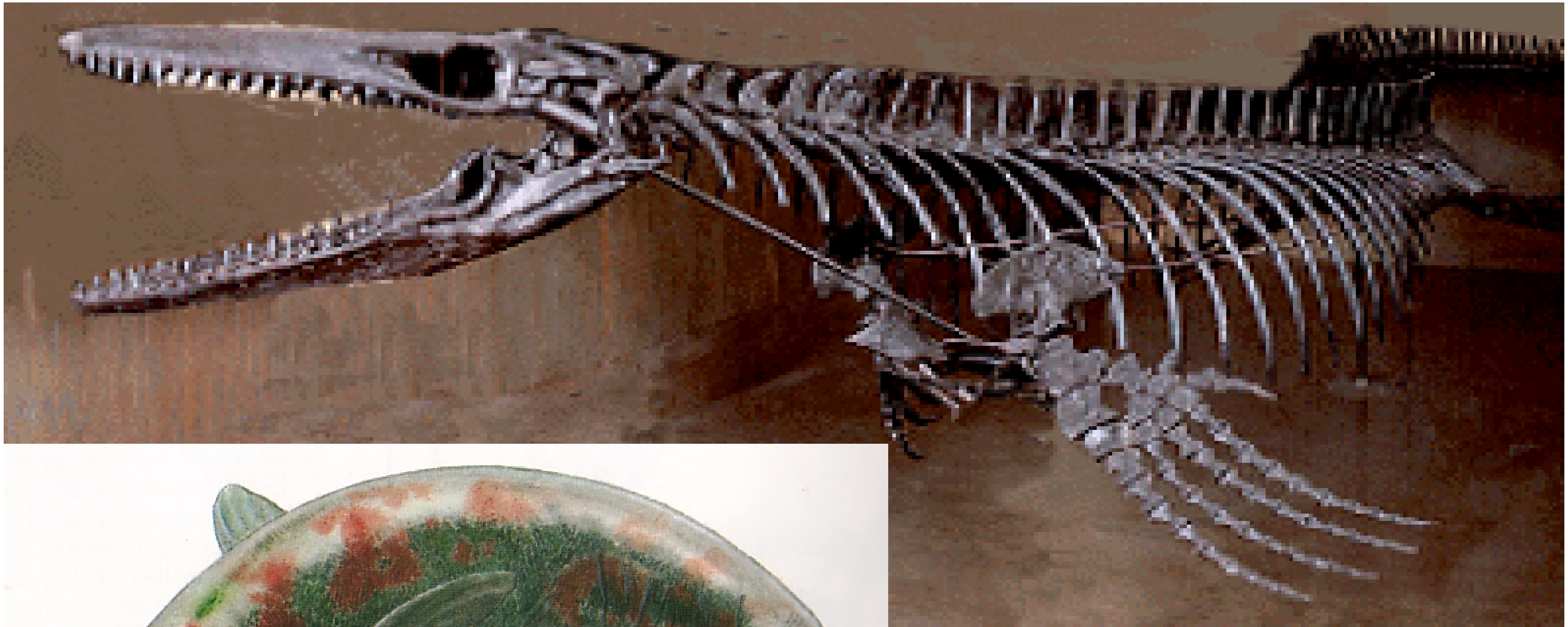
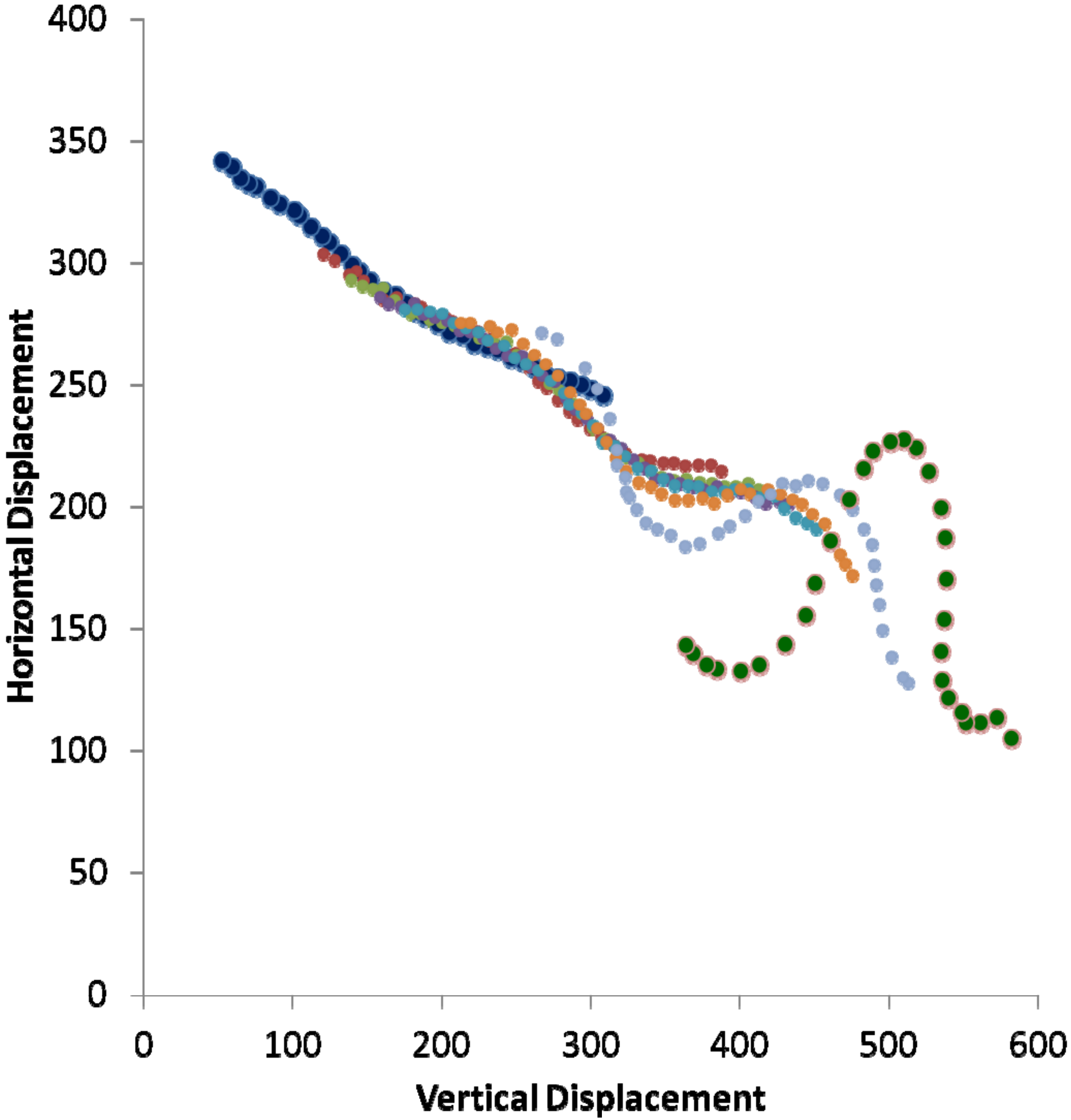
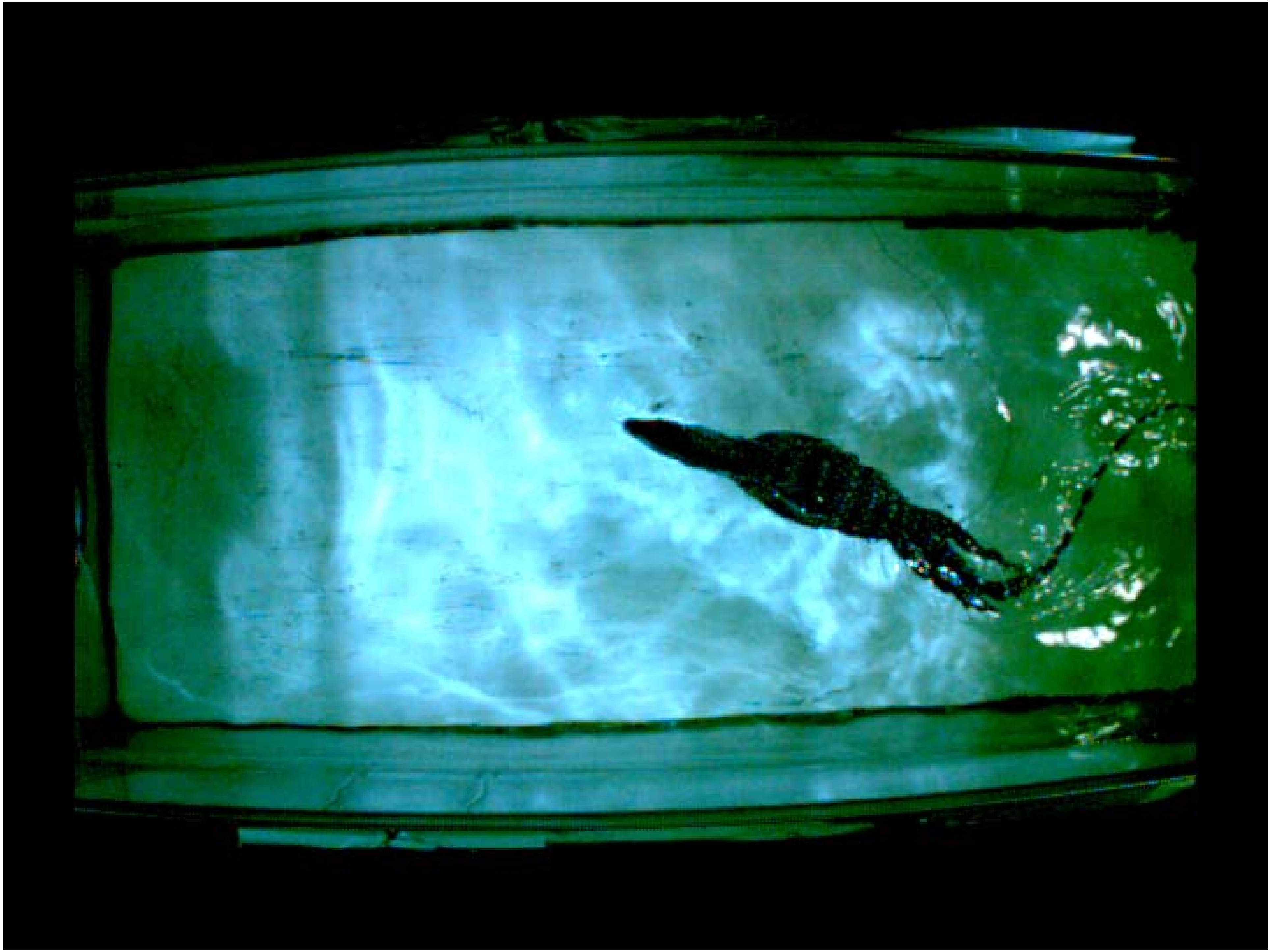




400
350
300
250
200
150
100
50
0
Horizontal Displacement
0
100
200
300
400
500
600
Vertical Displacement

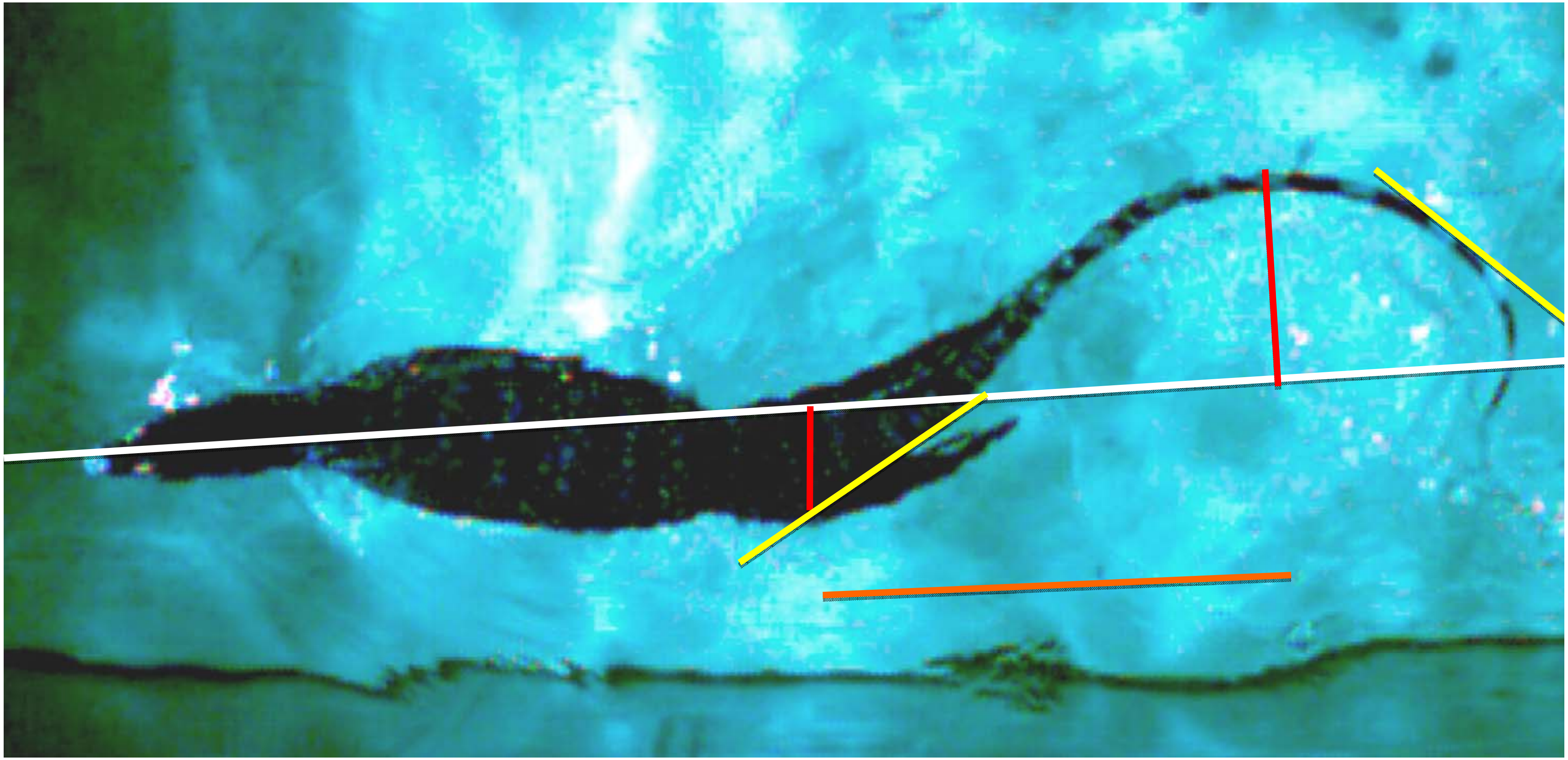


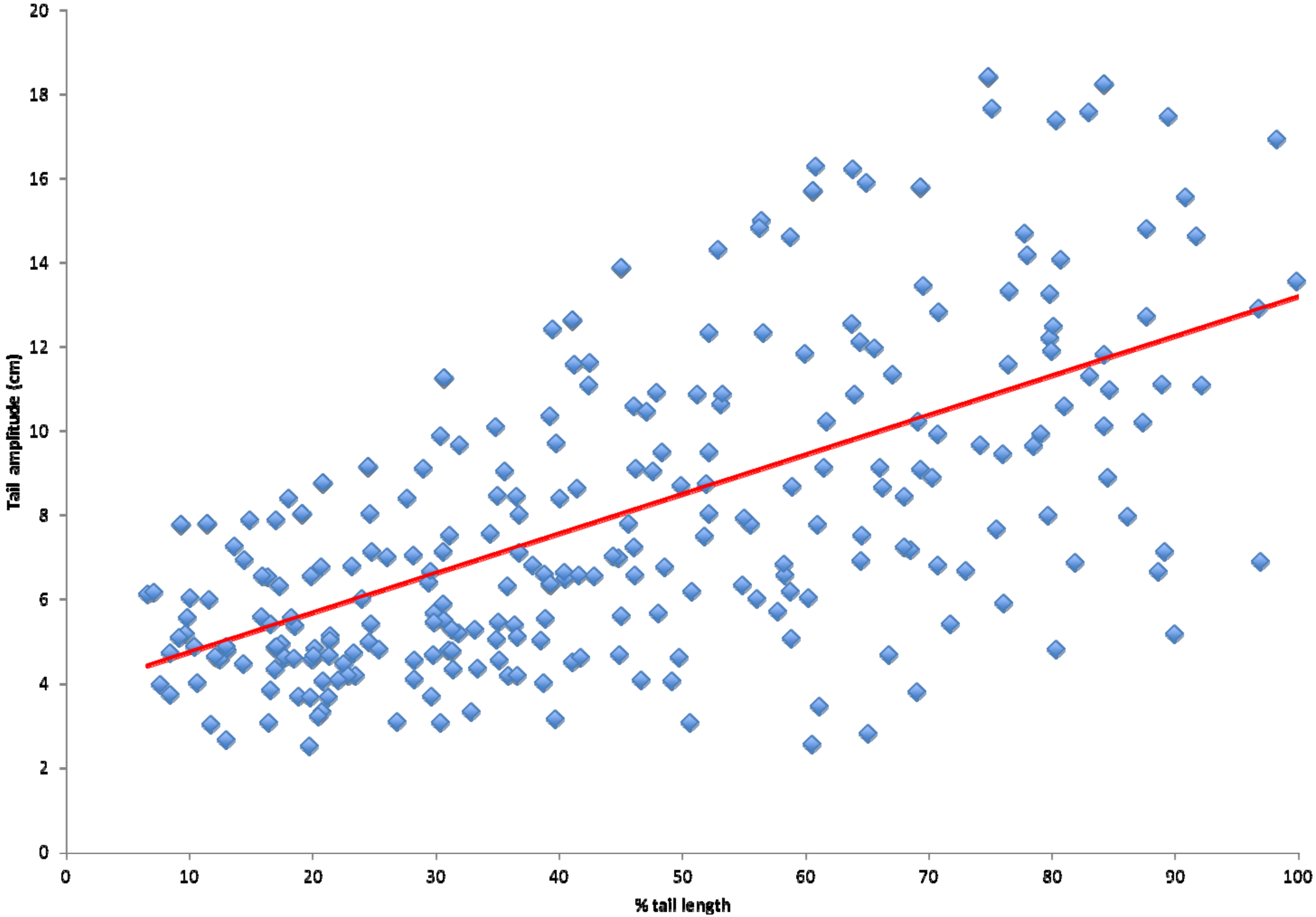
$$F_N = a\rho_f C_N |v_\perp| v_\perp + \sqrt{8\rho_f a\mu |v_\perp|}\, v_\perp, \quad F_T = 2.7\sqrt{2\rho_f a\mu |v_\perp|}\, v_\parallel.$$

$$\mathbf{n} = \hat{\mathbf{e}}_y \cos\varphi - \hat{\mathbf{e}}_x \sin\varphi, \quad \mathbf{t} = \hat{\mathbf{e}}_x \cos\varphi + \hat{\mathbf{e}}_y \sin\varphi$$

$$\mathbf{W} = -F_N\,\mathbf{n} - F_T\,\mathbf{t}$$

From Taylor (1952)
McMillen and Holmes (2006)



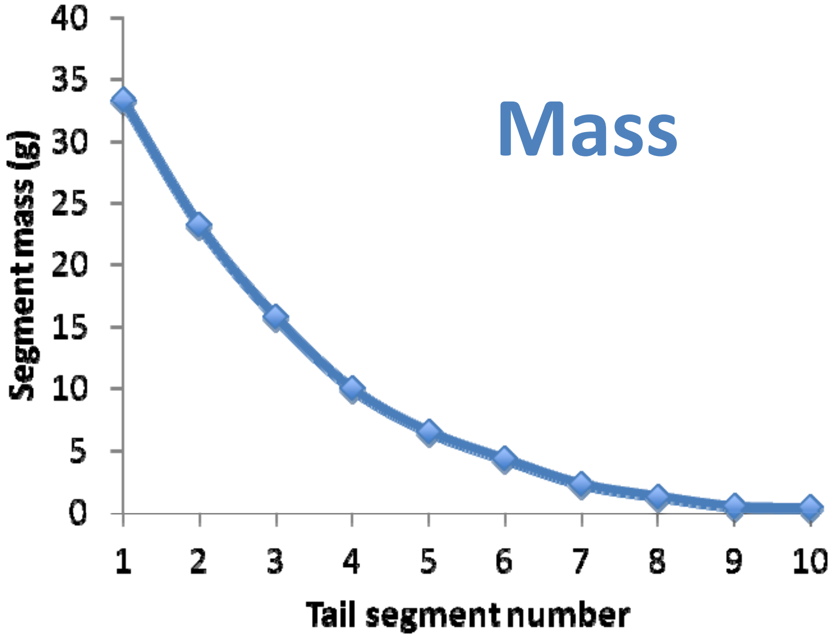


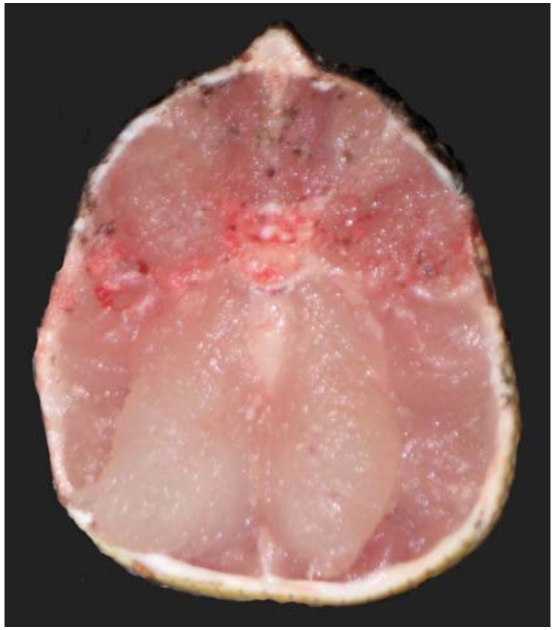
Tail amplitude (cm)
% tail length
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80
90
100

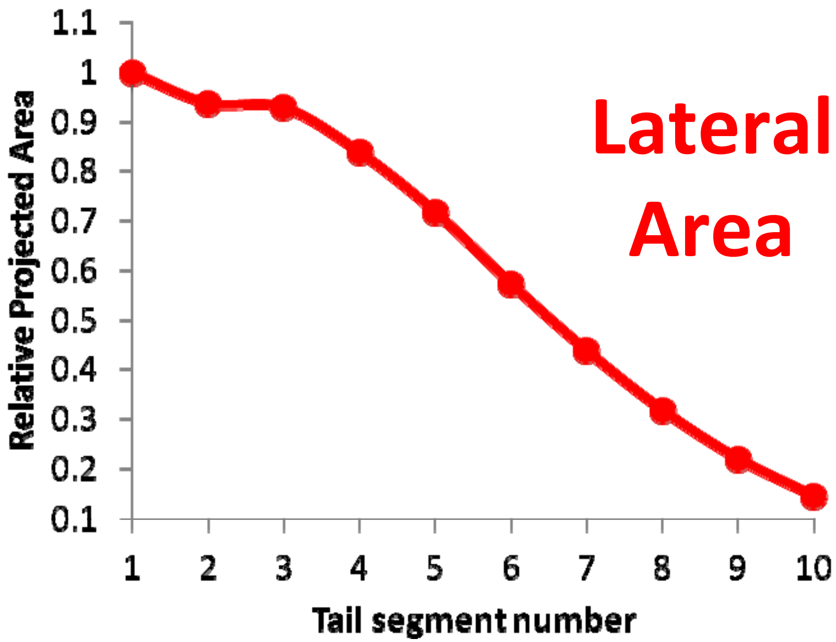
Along the length of the tail

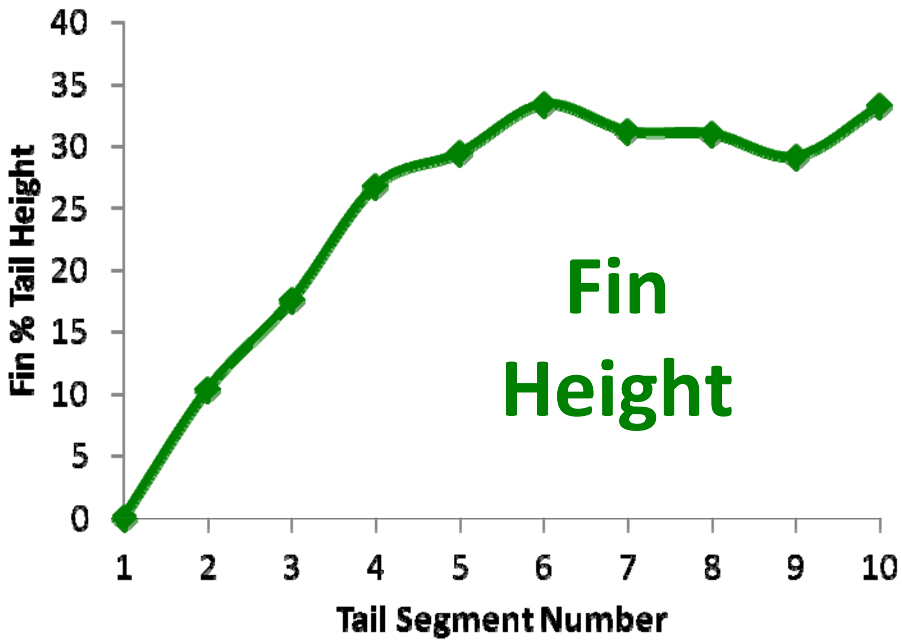
- Oscillatory amplitude increases
- Wavelength increases
- Oscillation frequency increases
- Velocity increases


Negative angles of attack at the tail tip

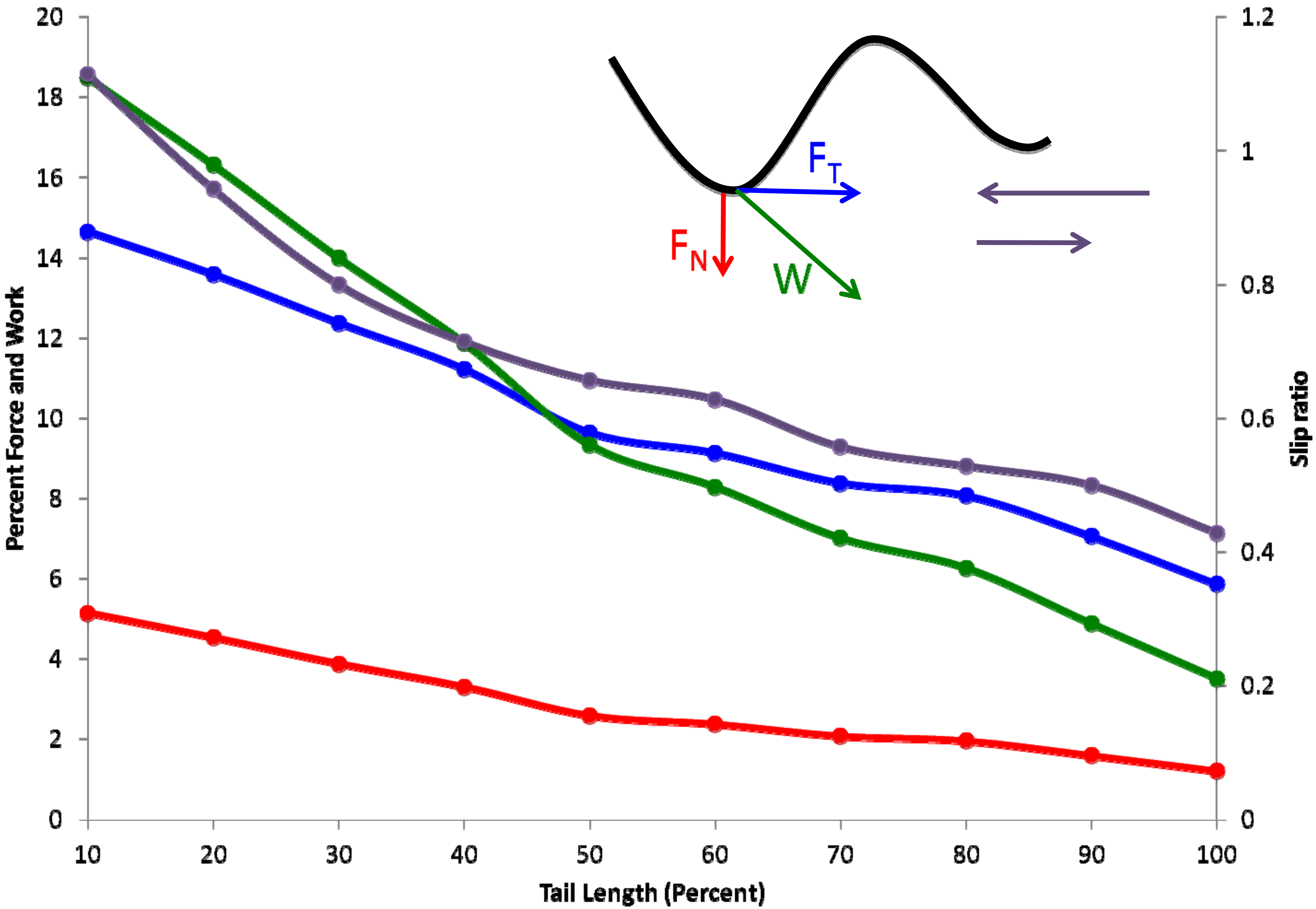

Mass
Segment mass (g)
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10
Tail segment number




Lateral
Area
Relative Projected Area
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1 2 3 4 5 6 7 8 9 10
Tail segment number

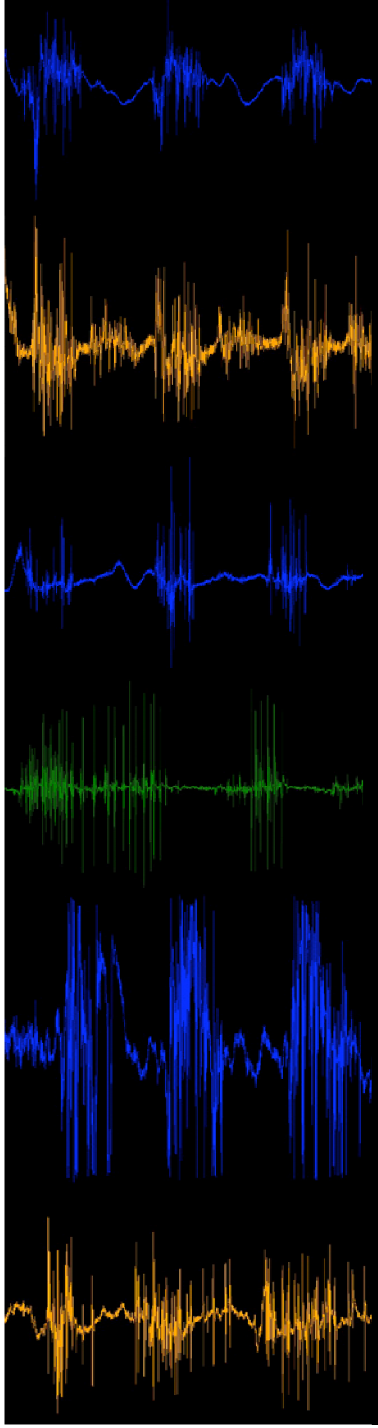

Fin
Height
Fin % Tail Height
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10
Tail Segment Number

How does the tail function in propulsion?

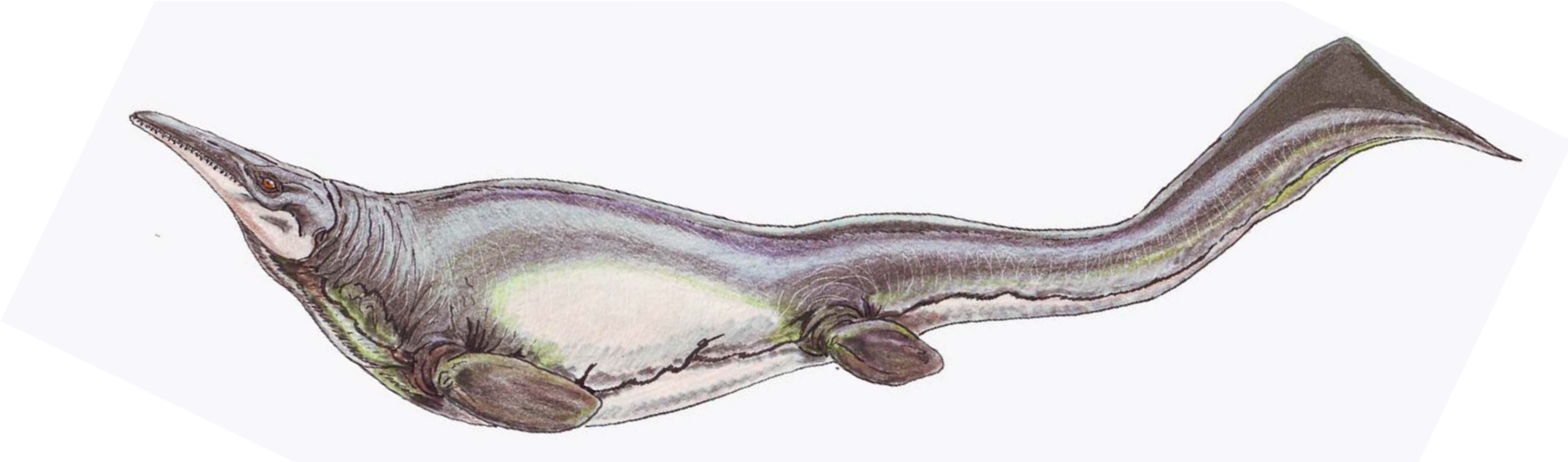


20
18
16
14
12
10
8
6
4
2
0
Percent Force and Work
1.2
1
0.8
0.6
0.4
0.2
0
Slip ratio
10
20
30
40
50
60
70
80
90
100
Tail Length (Percent)
F
T
F
N
W

In *Varanus salvator* the proximal third of the tail produces ~55% of propulsion, while the distal third produces ~ 15% of propulsion.

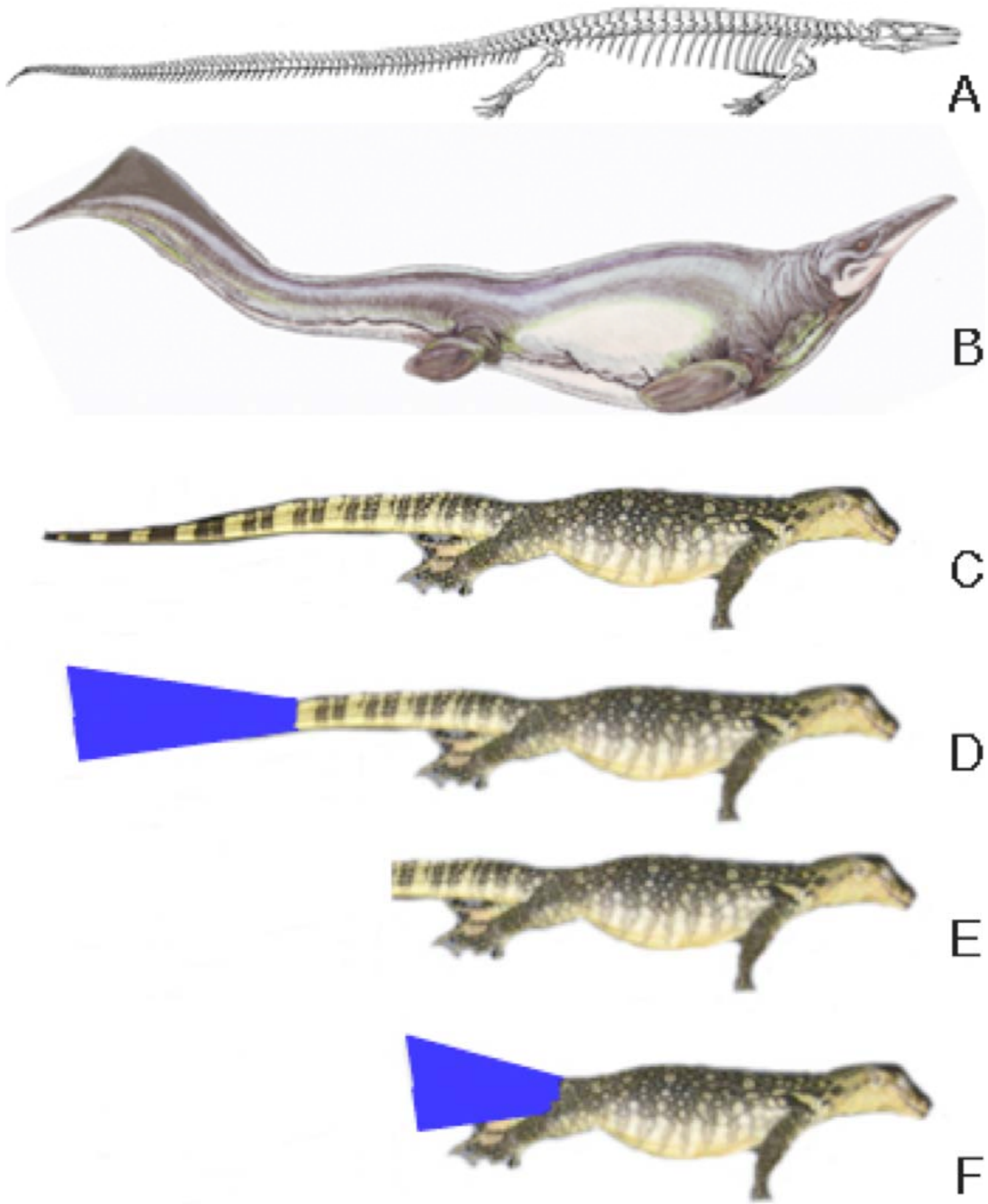


Advanced Imaging technologies, Electromyography, Sonometrics, Material Testing, Finite Element Analysis, 3-D morphometrics, and kinematic analysis



Tail length = 99.7% of pre-pelvis body length

Tail length = 121.9% of pre-pelvis body length


A
B
C
D
E
F

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Prof. Catherine Carr
Department of Biology
University of Maryland
(Functional neuroanatomy)

Prof. Jakob Christensen-Dalsgaard
Institute of Biology
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(Auditory electrophysiology)

Dr. Yezhong Tang
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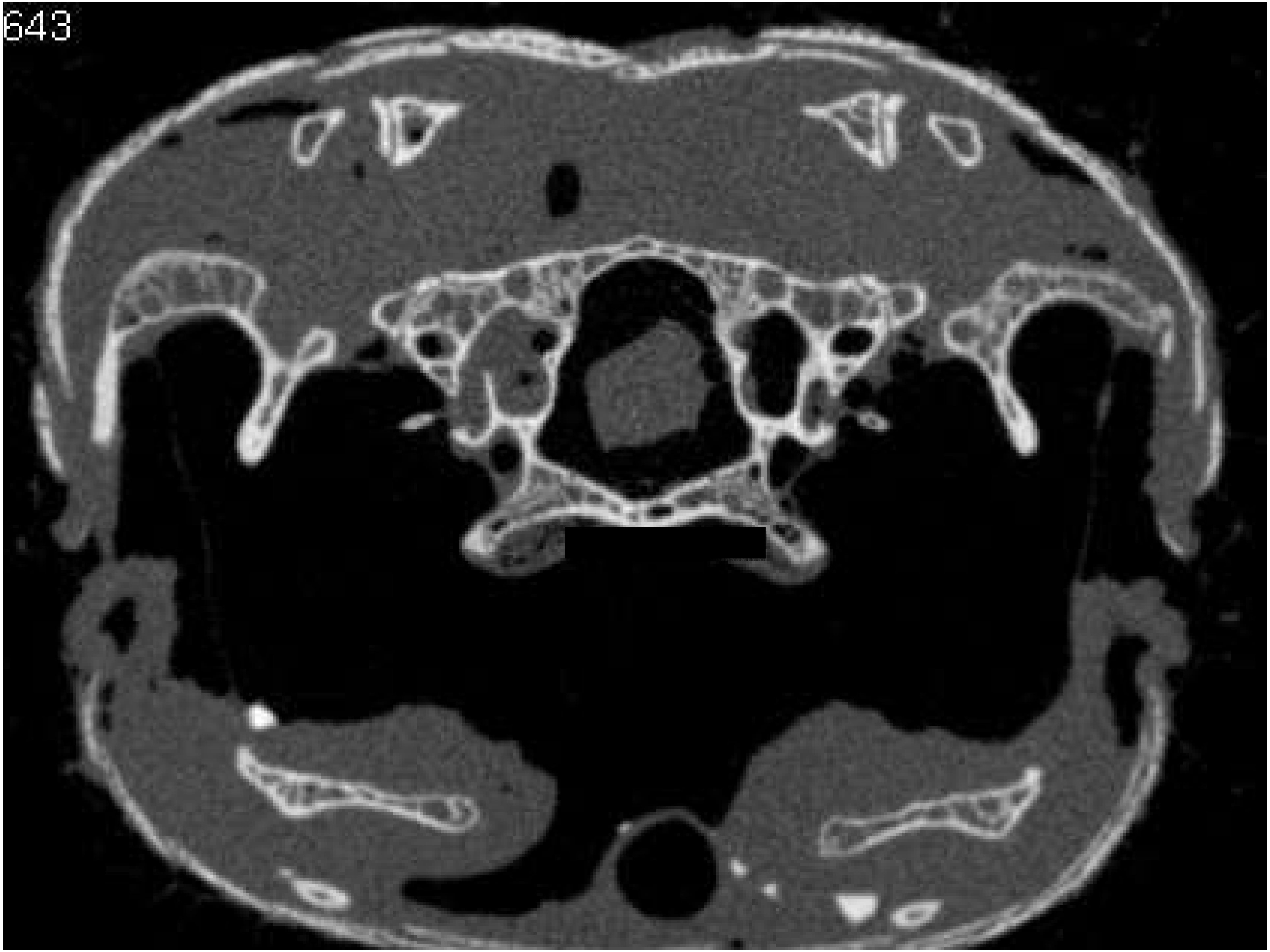
(Reptilian Neuronatomy)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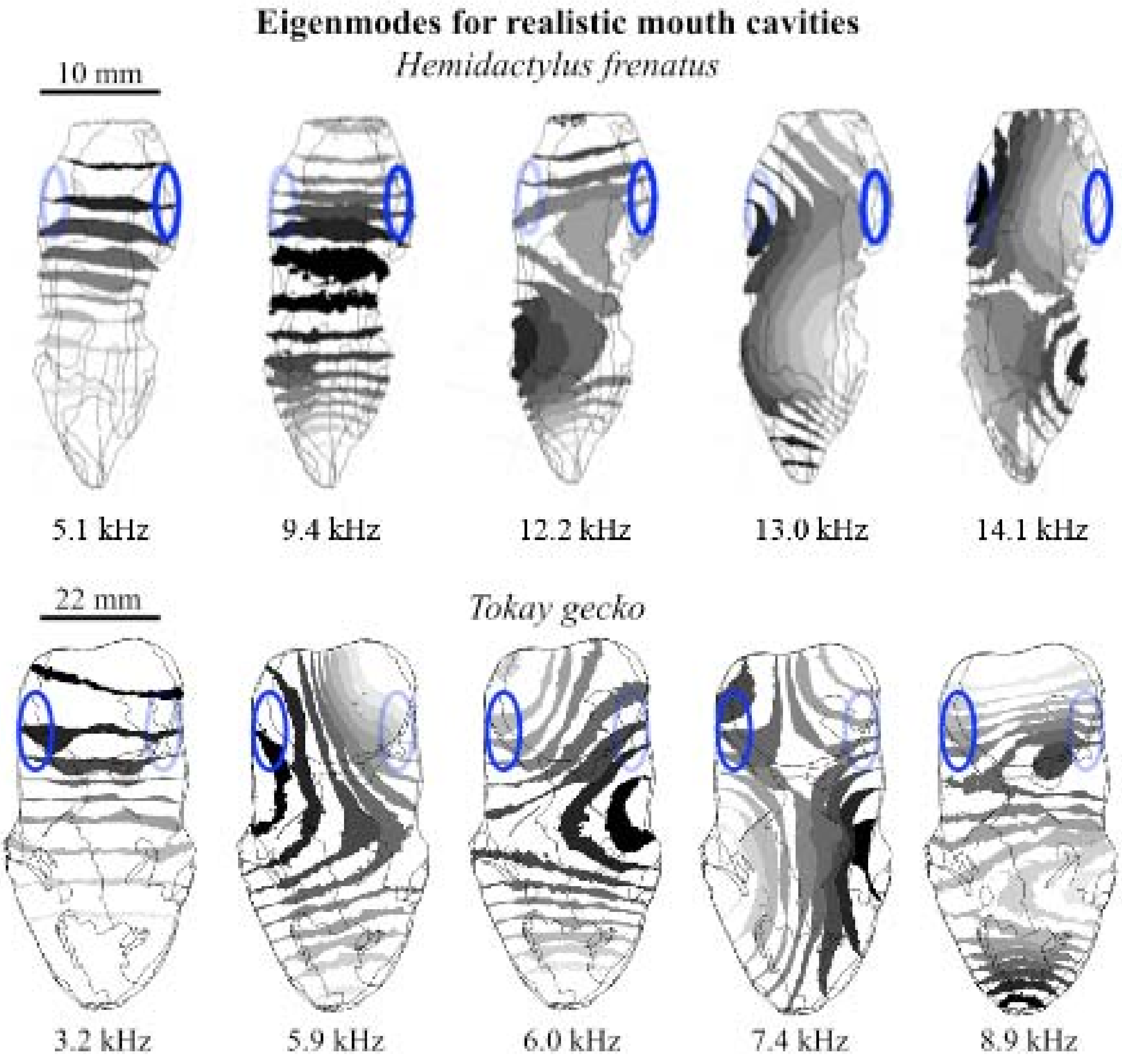
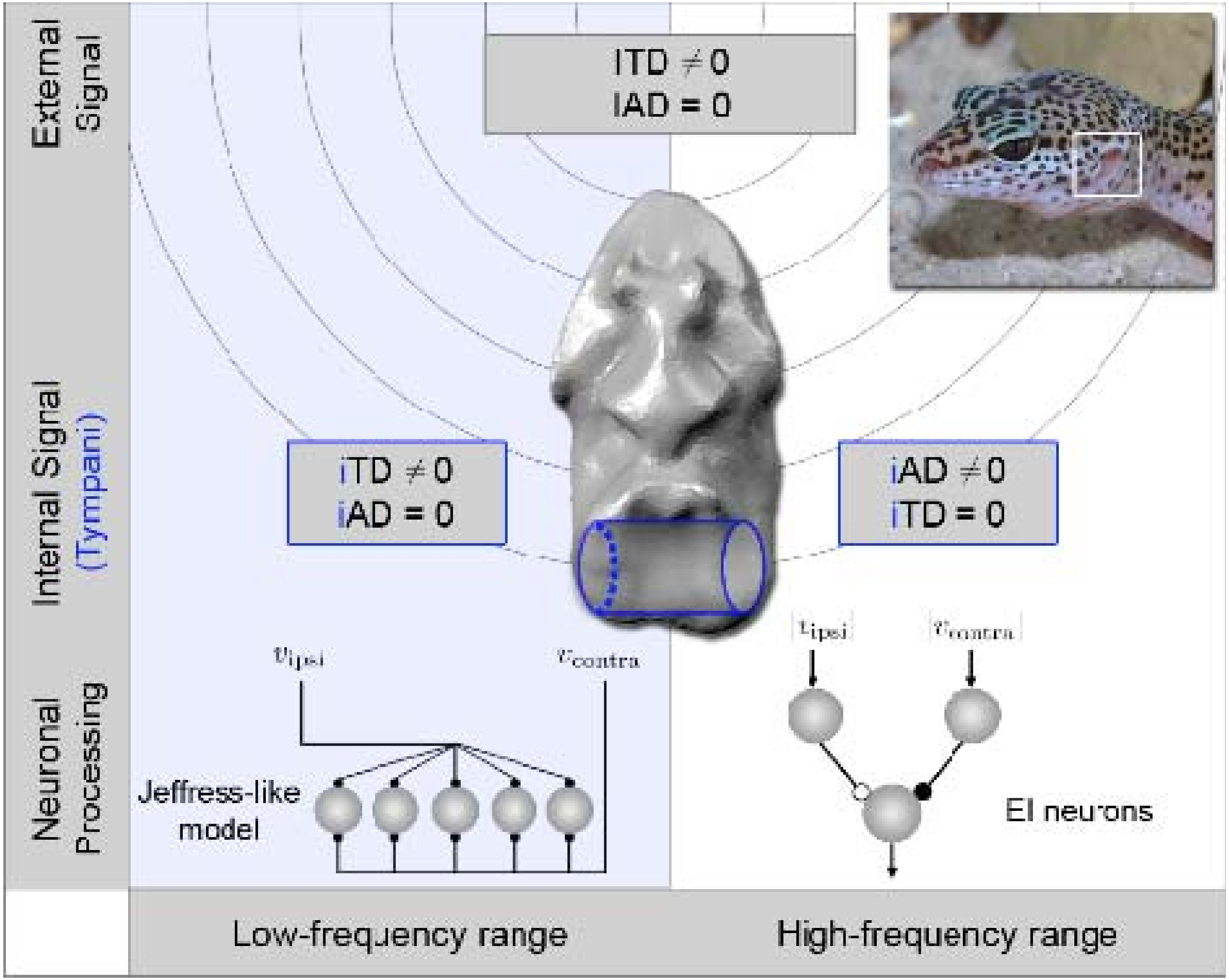
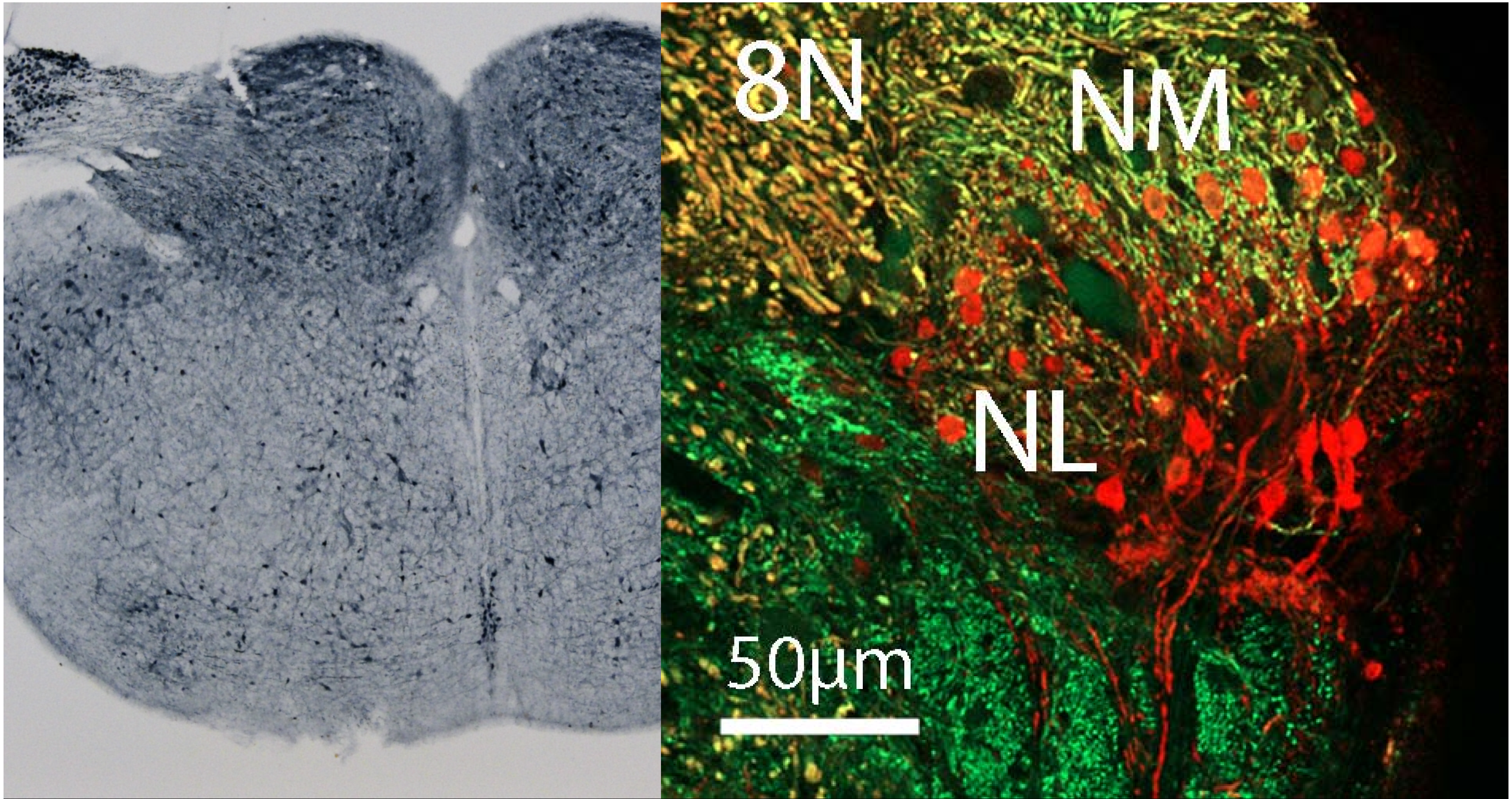
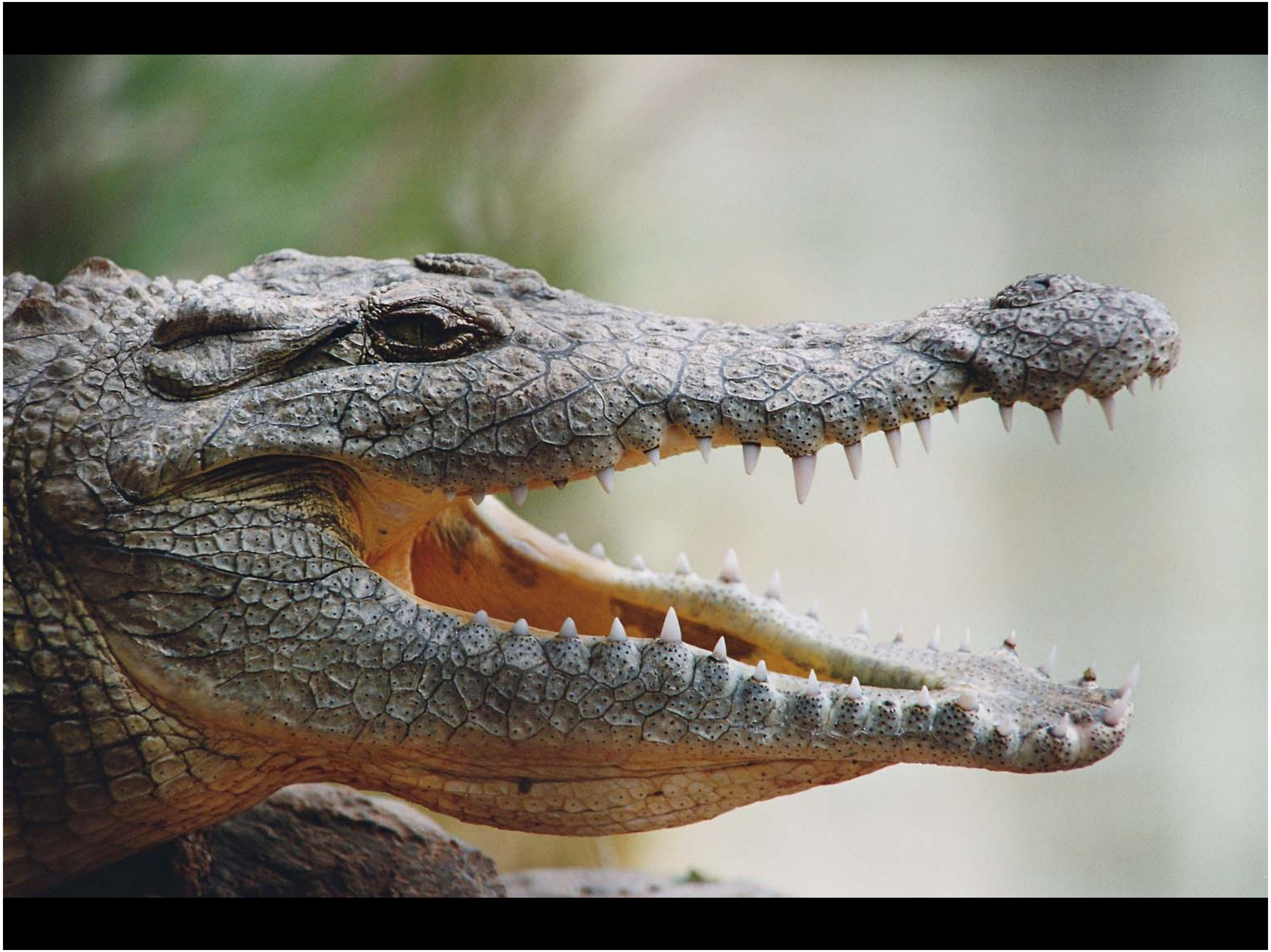

Eigenmodes for realistic mouth cavities
Hemidactylus frenatus
10 mm
5.1 kHz
9.4 kHz
12.2 kHz
13.0 kHz
14.1 kHz
22 mm
Tokay gecko
3.2 kHz
5.9 kHz
6.0 kHz
7.4 kHz
8.9 kHz

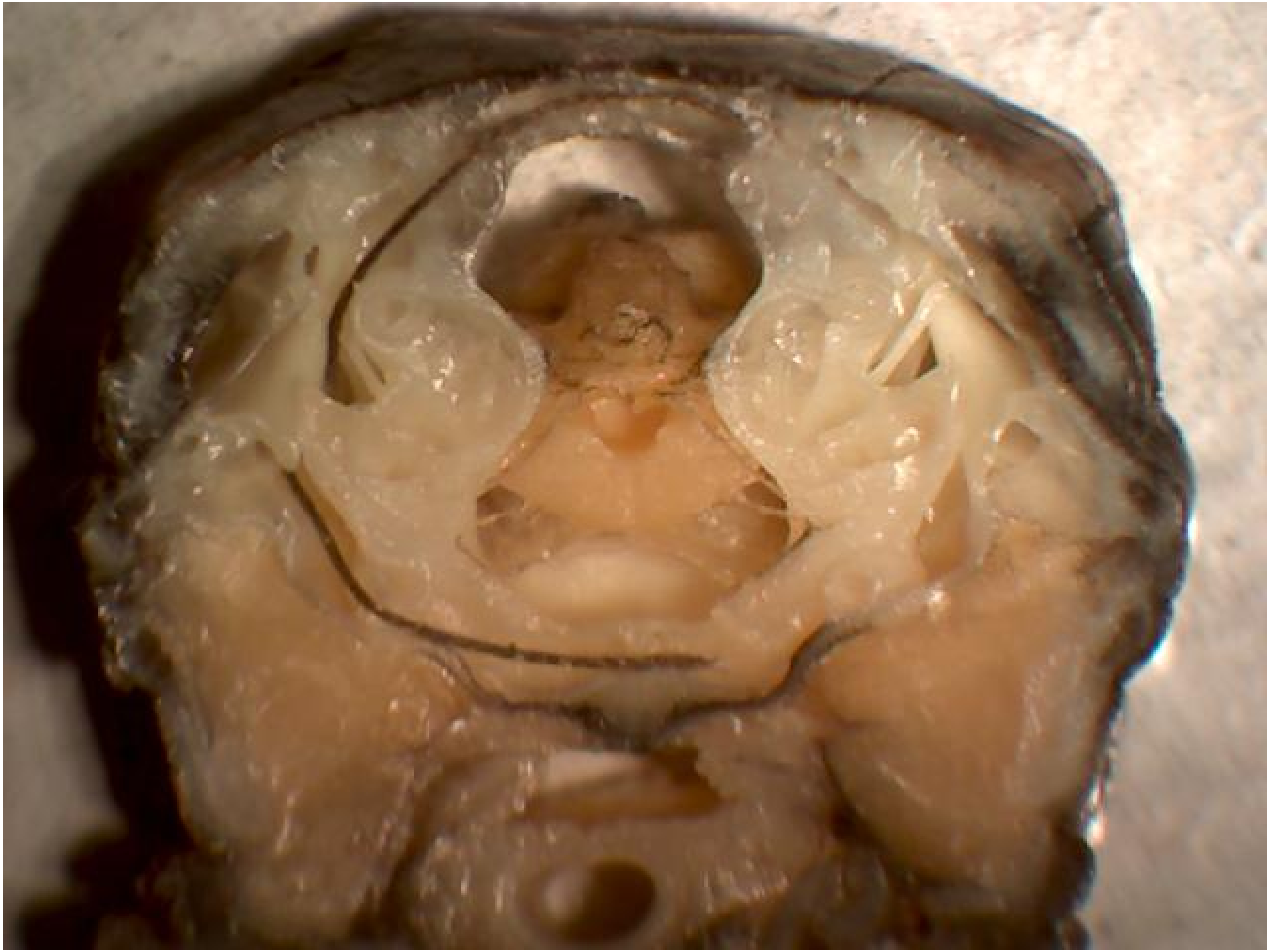


External Signal
Internal Signal (Tympani)
Neuronal Processing
ITD ≠ 0
IAD = 0
iTD ≠ 0
iAD = 0
iAD ≠ 0
iTD = 0
v_{ipsi}
v_{contra}
Jeffress-like model
EI neurons
Low-frequency range
High-frequency range



I use Neuroanatomical techniques to map out the auditory system in reptiles

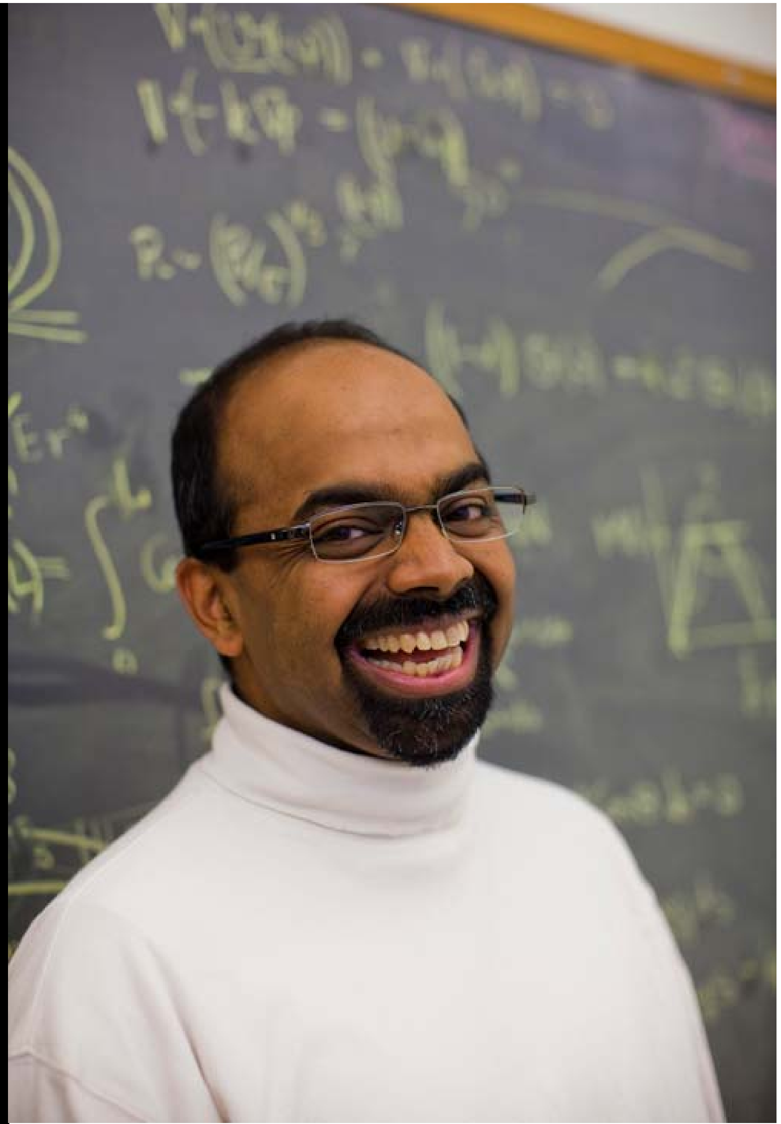




Measurement of sound pressure transformation and anatomical examination support a role for pressure difference receiver in alligator sound localization. H. Bierman, J. Thorton, H. Jones, K. Kola, C. Carr, B. Young, and G. Tolin. SICB.

Evidence for low-frequency sound localization in the American alligator (*Alligator mississippiensis*). H. Bierman, C. Carr, C. Brandt, B. Young, and J. Christensen-Dalsgaard. SFN.

Biophysics of Snake Locomotion



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Departments of Applied Mathematics, Physics, and Biology
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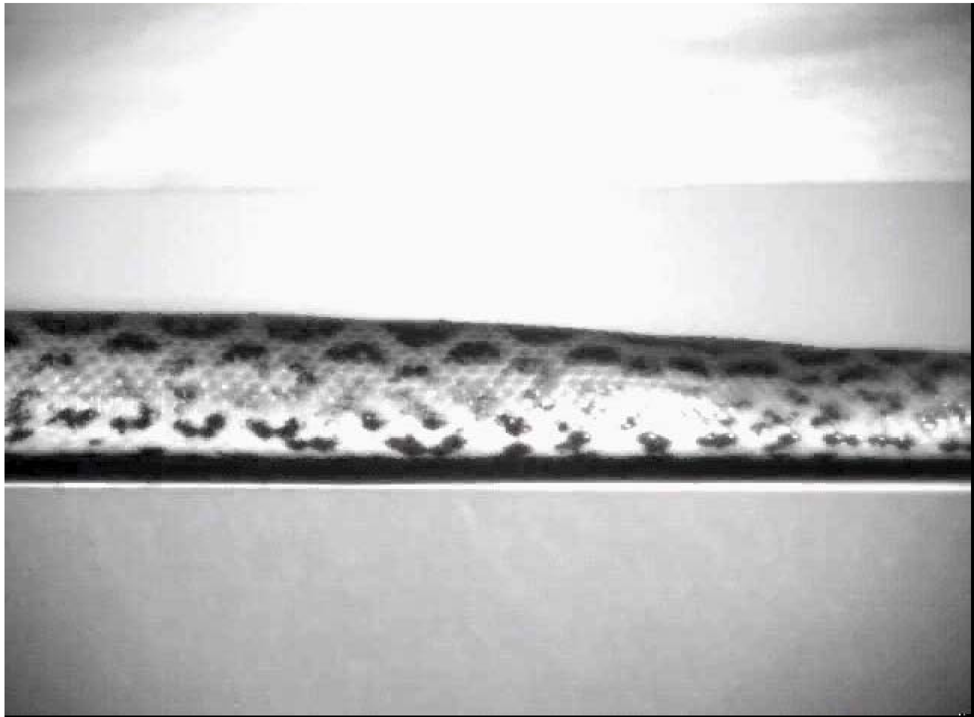
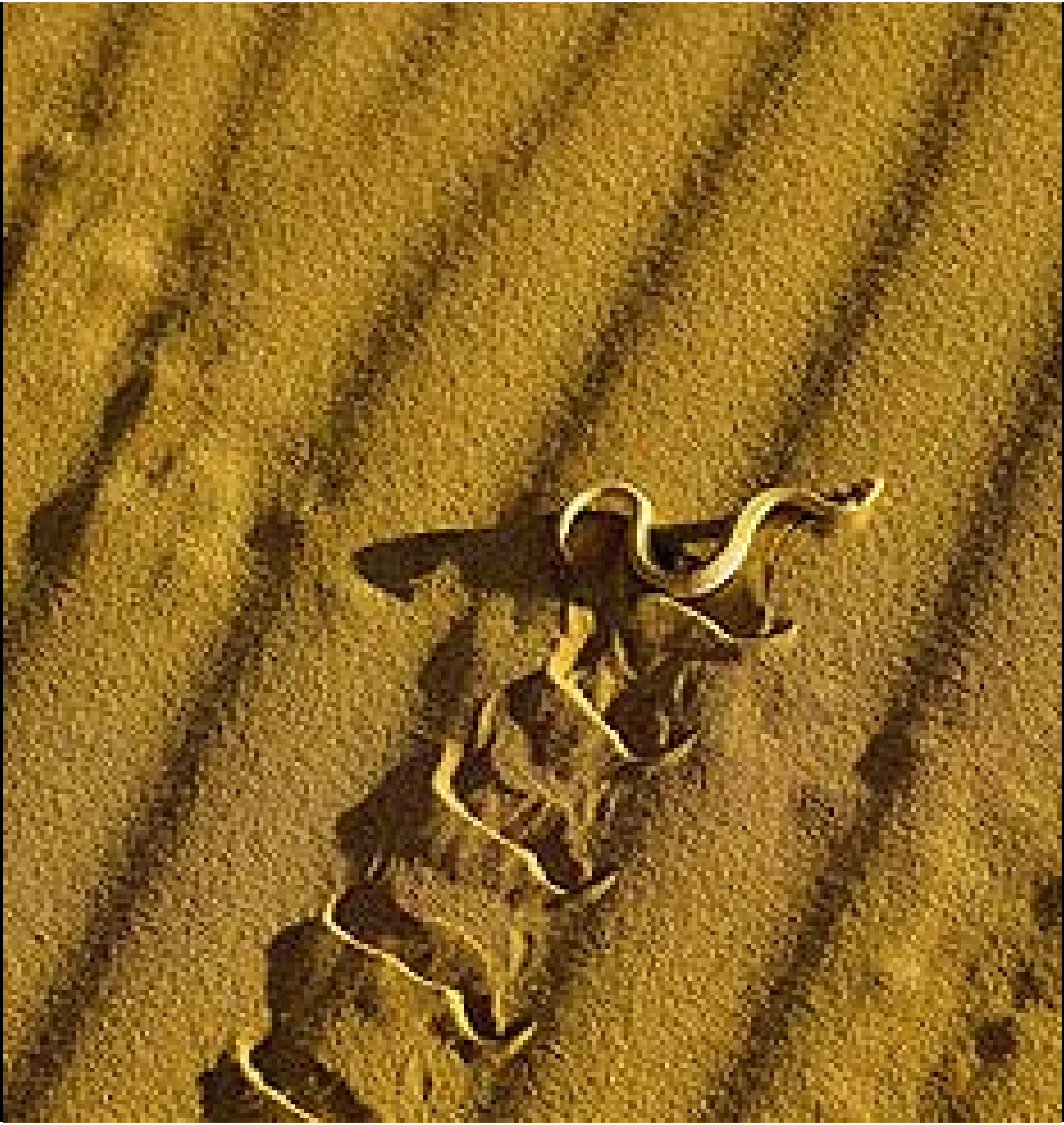
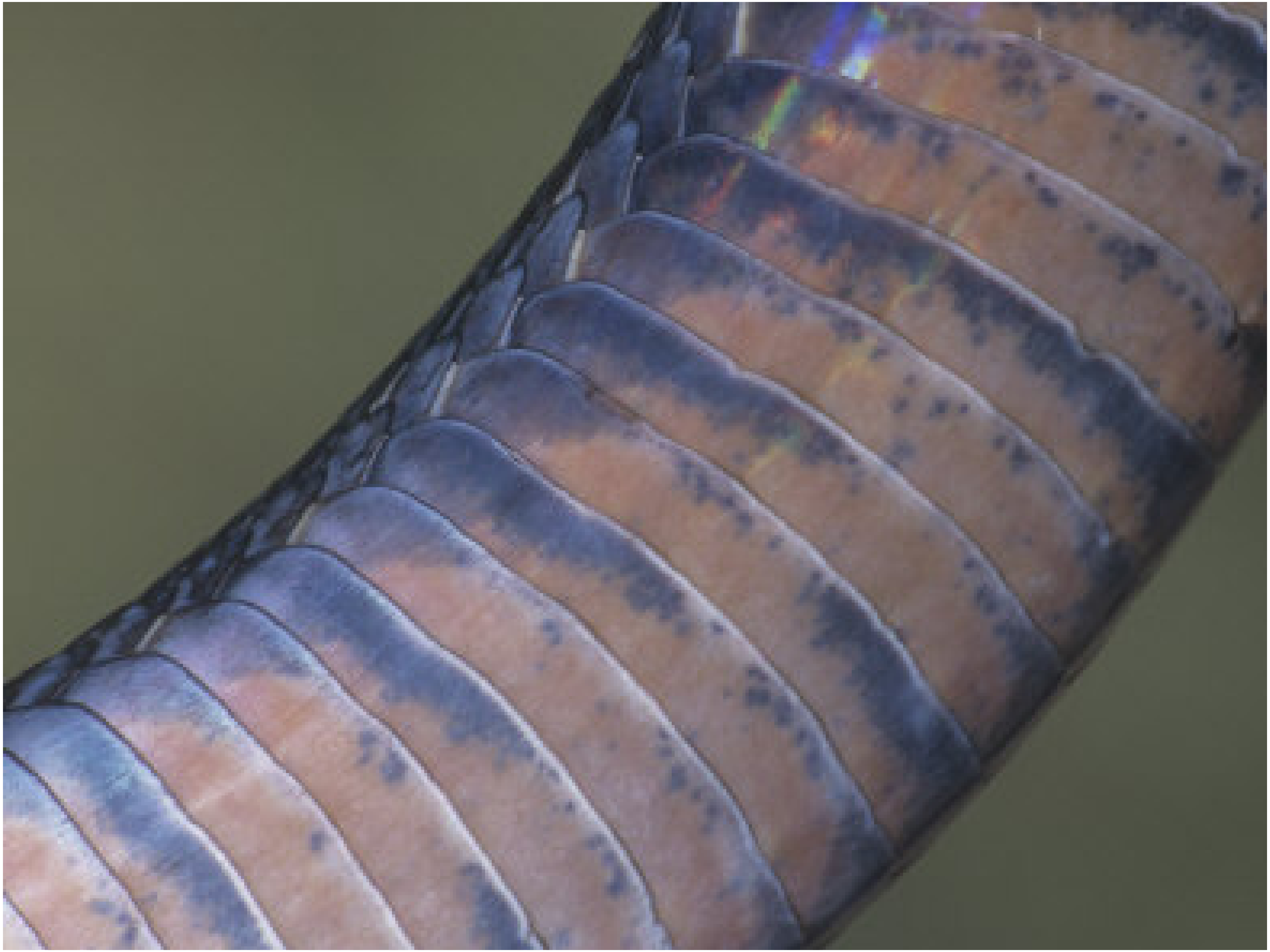


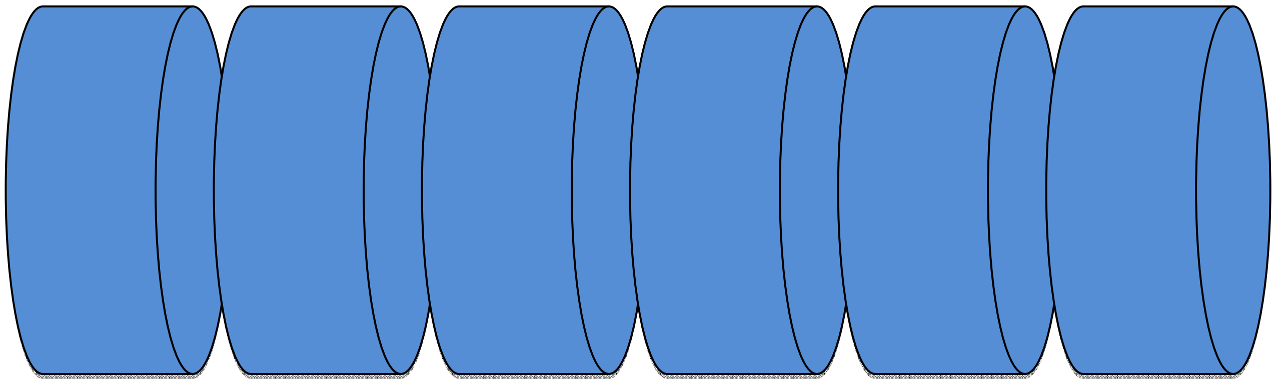



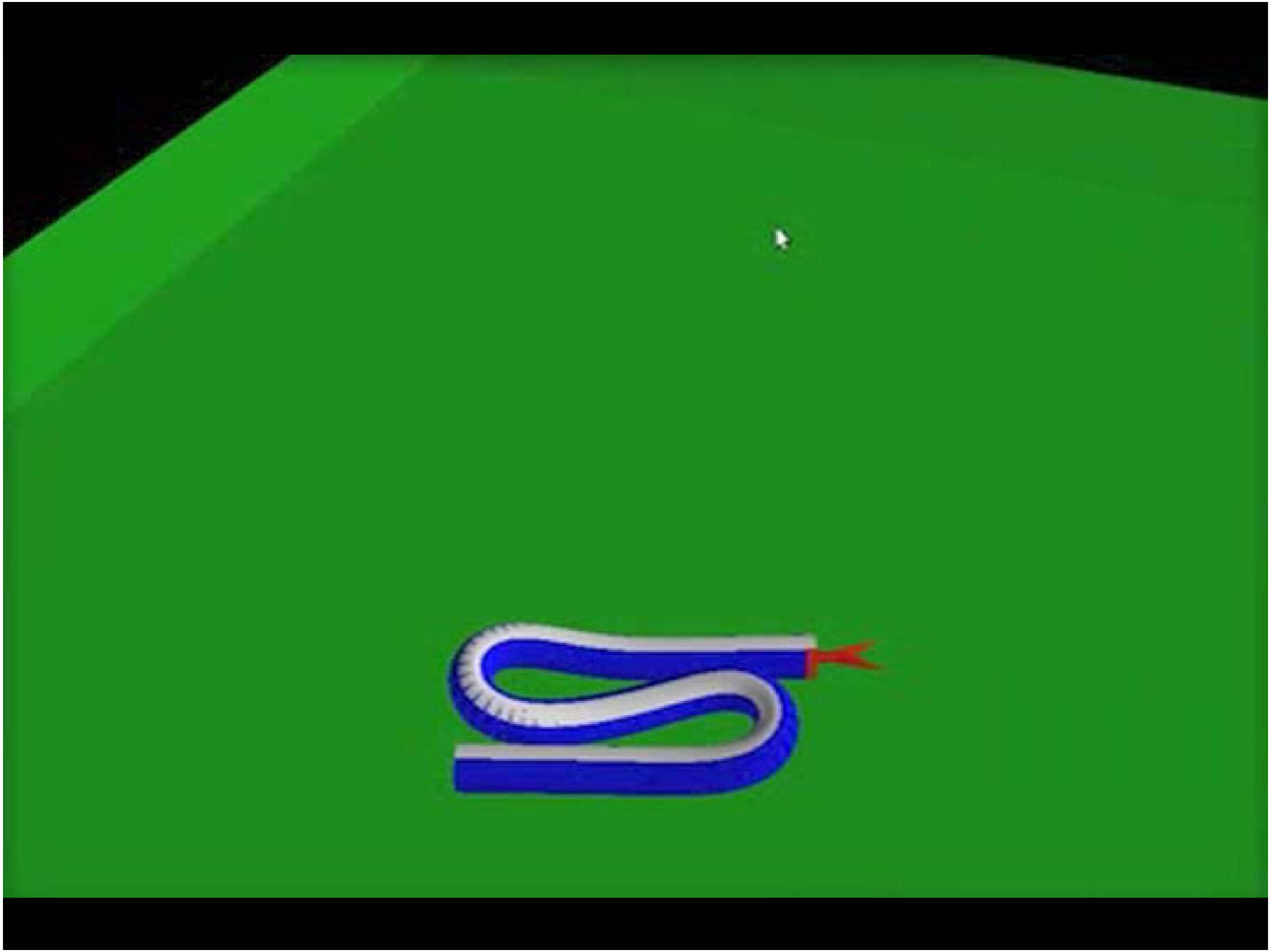
Key Parameters

- Velocity of wave propagation
- Elevation of the segment
- Radius of loop curvature
- Frictional anisotropy



Kirchoff Rod — an elastic body that resists stretching, bending, and twisting



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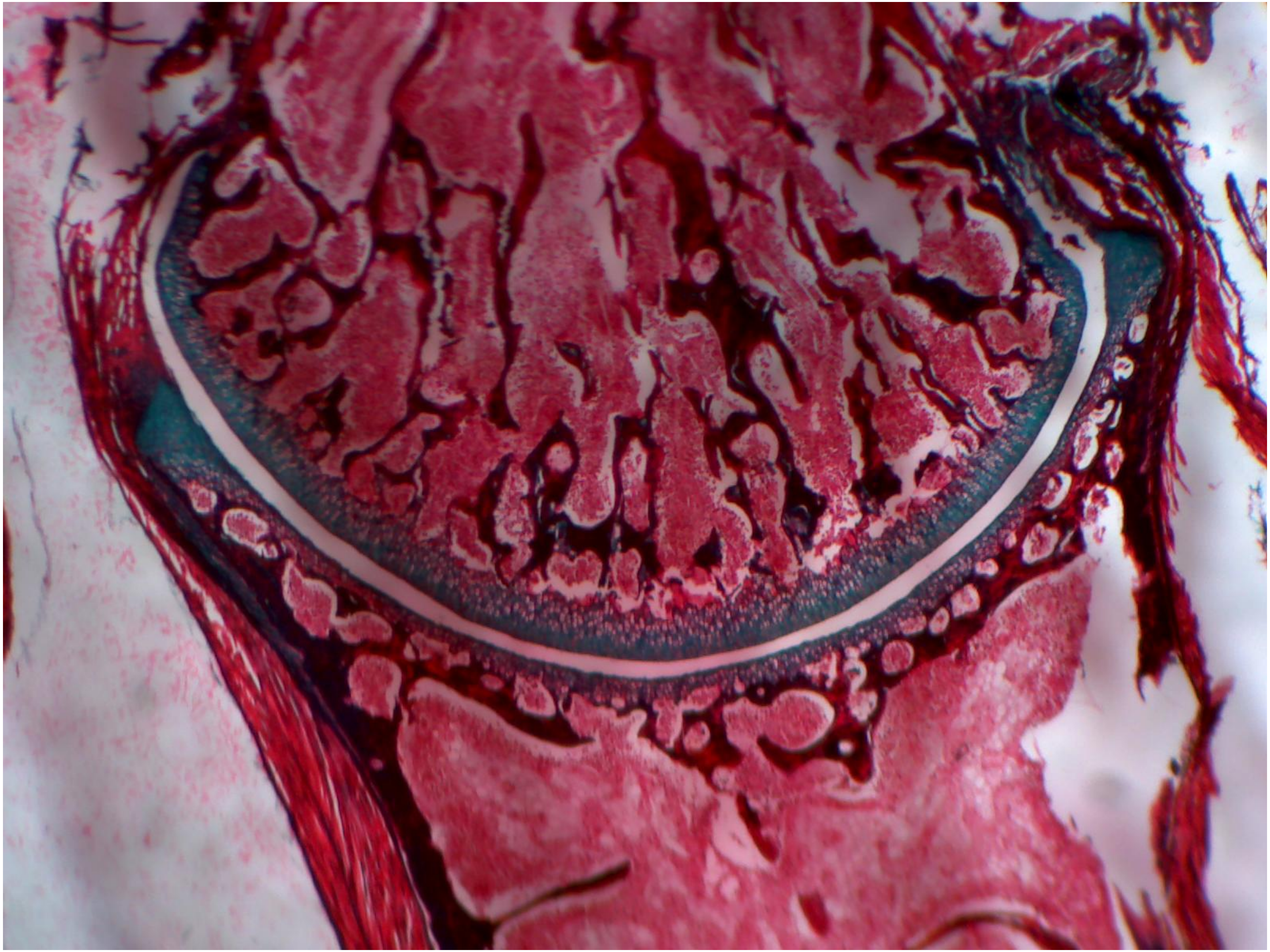
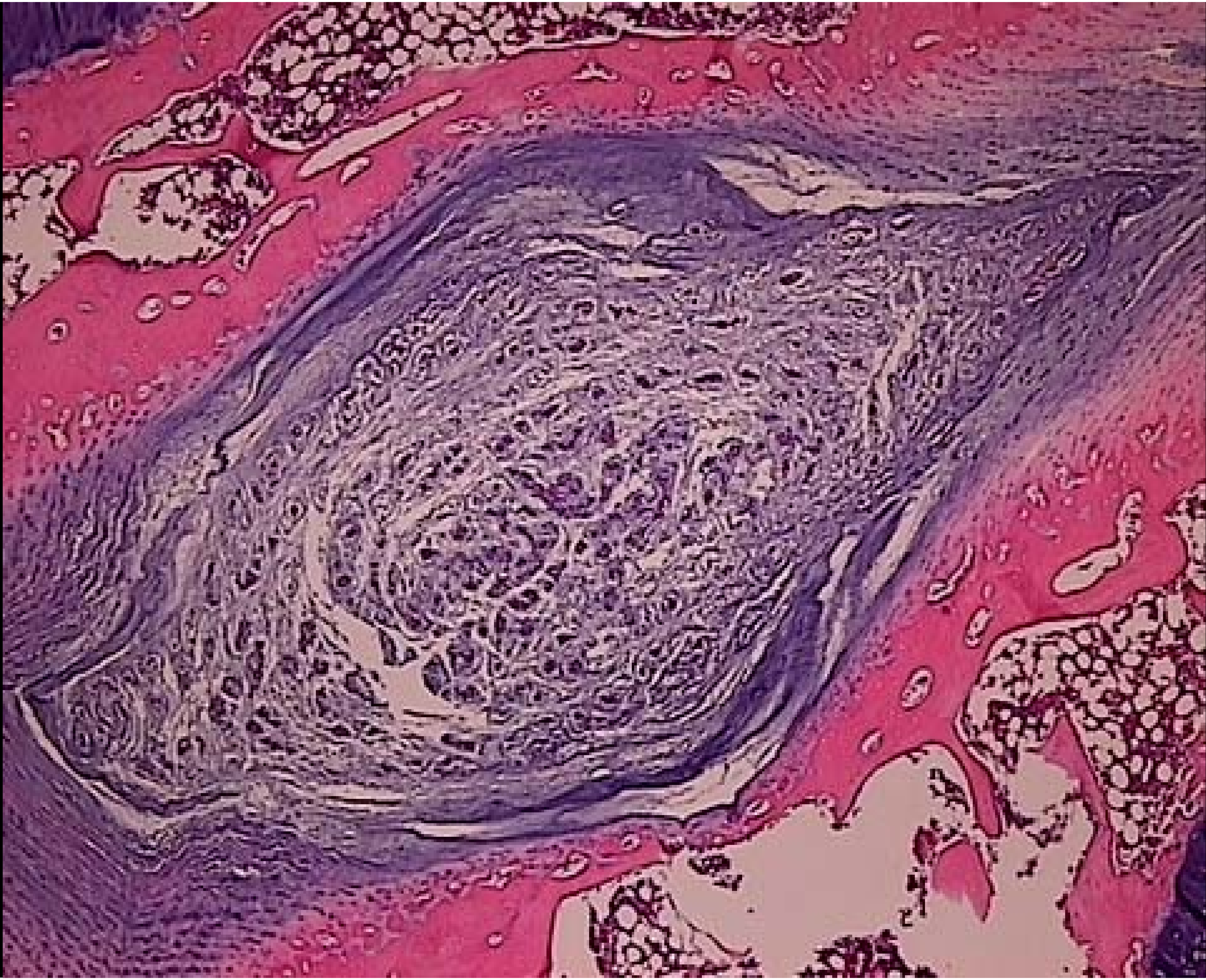
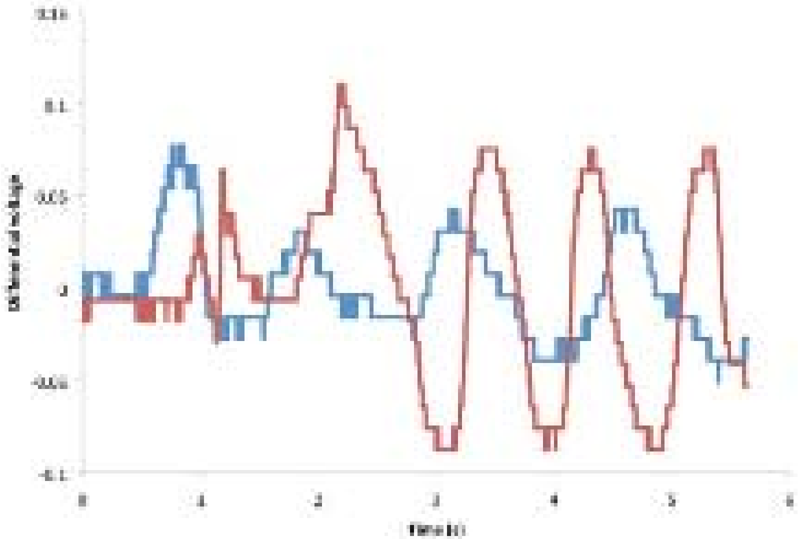
LIBERTY
QUARTER DOLLAR





Sonometric data for



Force (Y axis) over Displacement (X axis)
For caudal vertebrae being oscillated
Over a fixed amplitude at either 0.1 Hz
(Blue) or 1.0 Hz (Red).