The walking fish: analysis of radial bones in *Polypterus senegalus*

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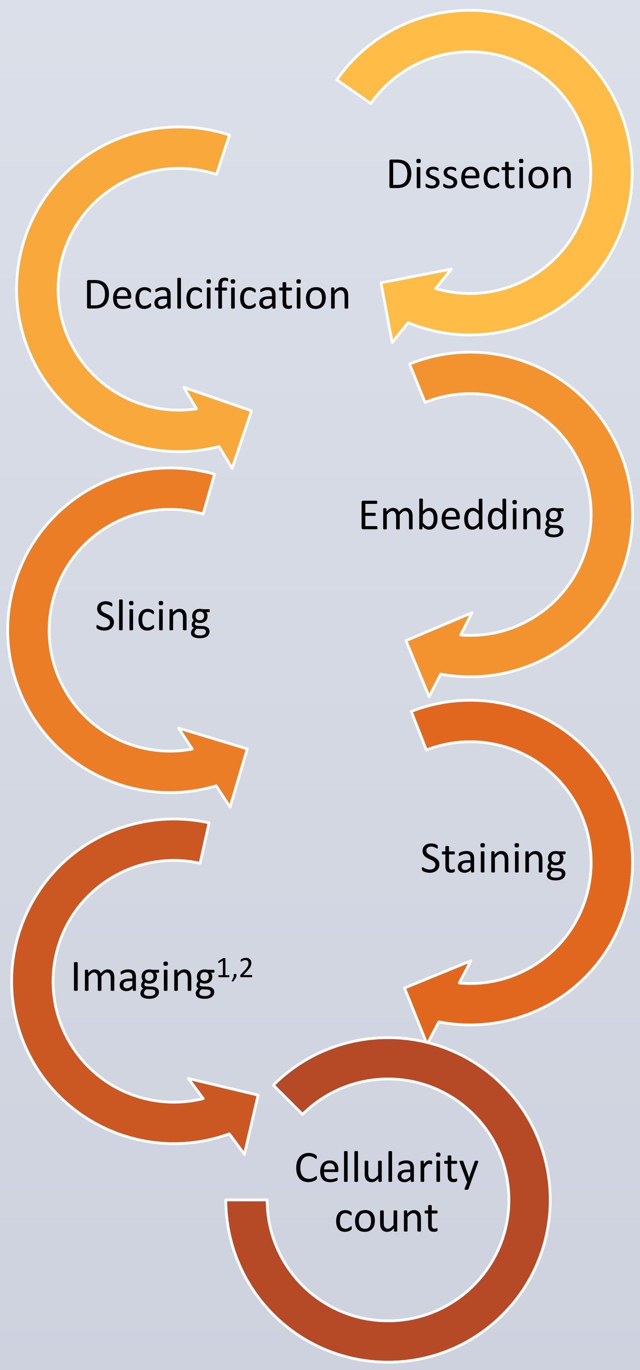
Introduction

One of the main evolutionary adaptations that organisms had to undergo to progress from the aquatic to the terrestrial environment was the change in locomotion from swimming to walking. This evolutionary transition gave rise to species capable of both forms of locomotion. The problem, however, is that the forces experienced during swimming and walking are completely different and distinct. *Polypterus senegalus*, a fish capable of both forms of locomotion, utilize their pectoral fins to both walk and swim leading to the question: what is the cellular structure and material properties of these radial bones that allow them to experience these different forces. To answer this question, I am specifically looking at the histology and cellular structure of these radial bones. This project will ultimately contribute to a better understanding on how aquatic organisms progressed onto land and it will help realize the evolutionary development of joints and how bone and cartilage work together to withstand different forces.[3]

Methodology



Results

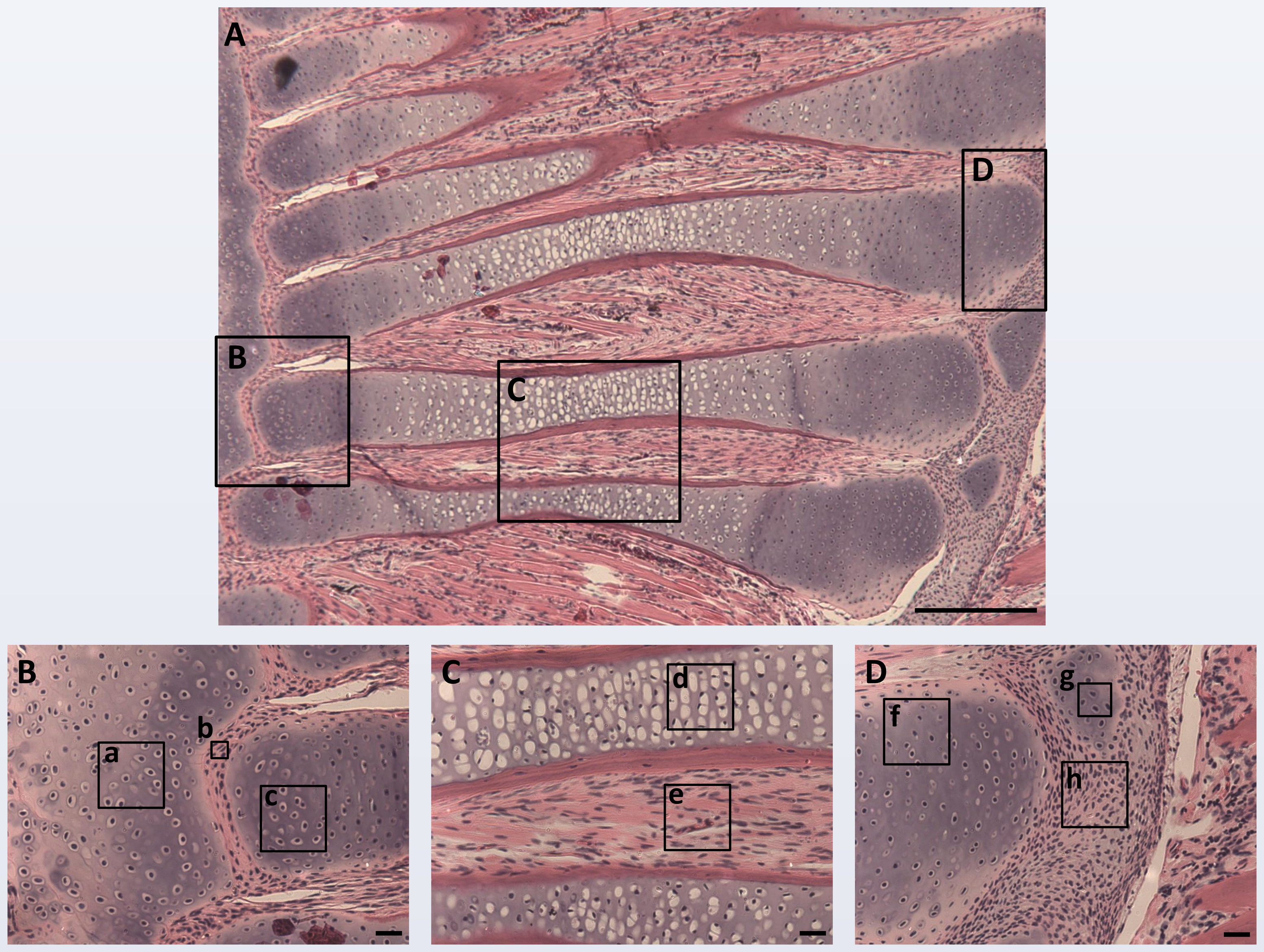


Figure 1: The right fin of *Polypterus senegalus* 09 sliced and stained with Haemotoxylin and Eosin (H&E) and imaged using light microscopy. This right fin is sliced from its medial side, where the right side of the images are distal and the left side of the images are proximal. (A) A section sliced at 5um, stained with H&E, and imaged at 4x magnification, the scale bar represents 580um. (B)(C)(D) Images taken of section (A) at 20x magnifications, where the scale bar represents 50um.

Table 1: Regions a-h of figure 1(B-D) are all analyzed by Image J to perform a nuclei count to observe cellularity. Each region is corrected to represent the number of nuclei in 100um^2 of tissue. Region d was manually counted as many nuclei did not stain.

Section	a	b	c	d	e	f	g	h
Nuclei count per 100um^2	12	80	17	23	36	16	16	89

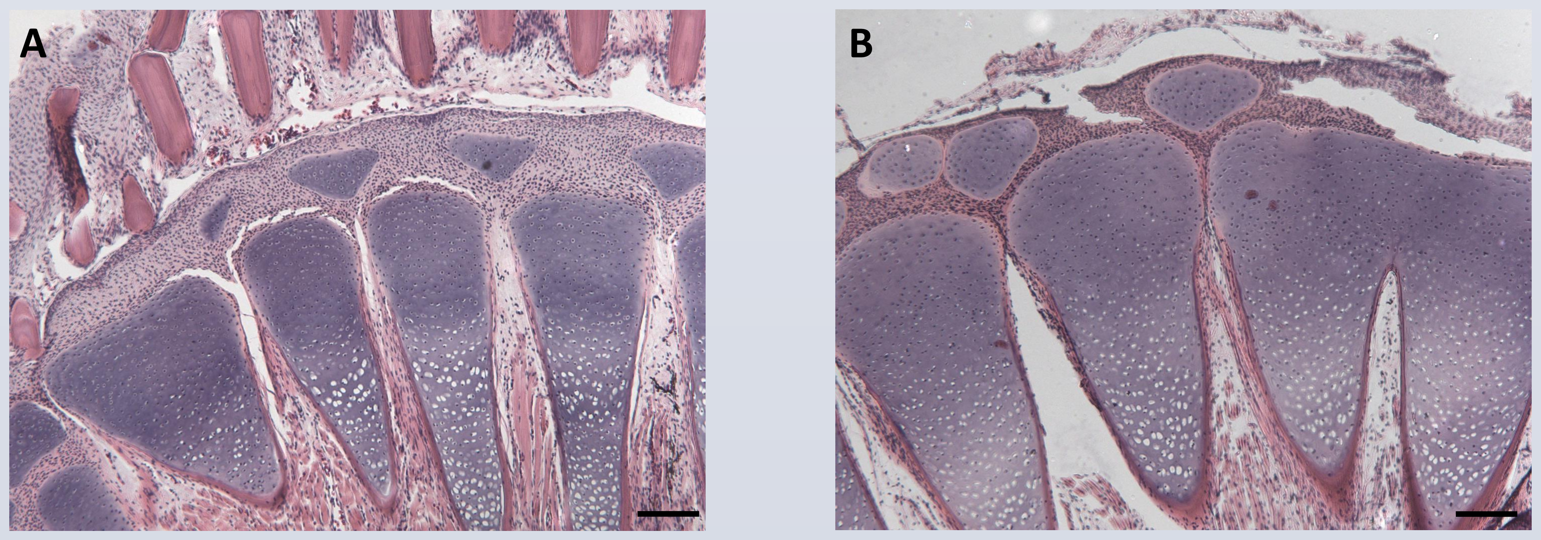


Figure 2: Images of the distal portions of the right fins of *Polypterus senegalus*. Both sections are sliced at 5um, stained with H&E, and imaged at 4x magnification. (A) is taken from the right fin of Polyp 06. (B) is taken from the right fin of Polyp 08. The scale bar for both images represents 340um.

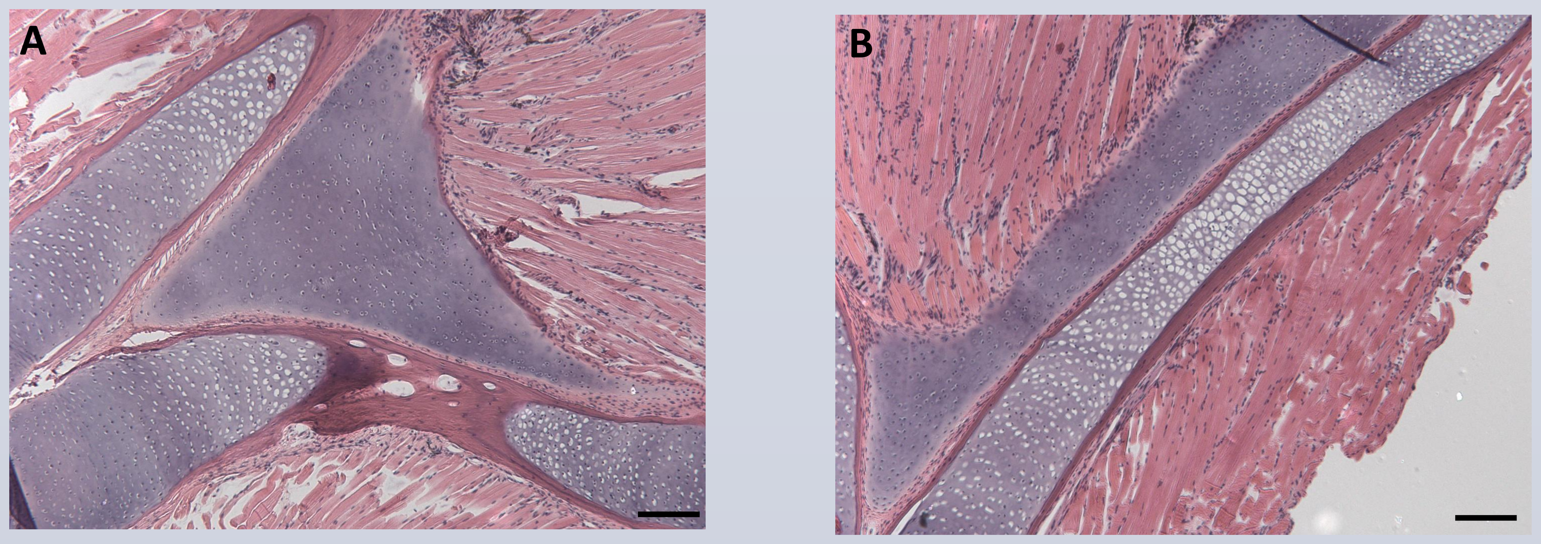


Figure 3: Images of the proximal portions of the right fins of *Polypterus senegalus*. Both sections are sliced at 5um, stained with H&E, and imaged at 4x magnification. (A) is taken from the right fin of Polyp 07. (B) is taken from the right fin of Polyp 10. The scale bar for both images represents 340um.

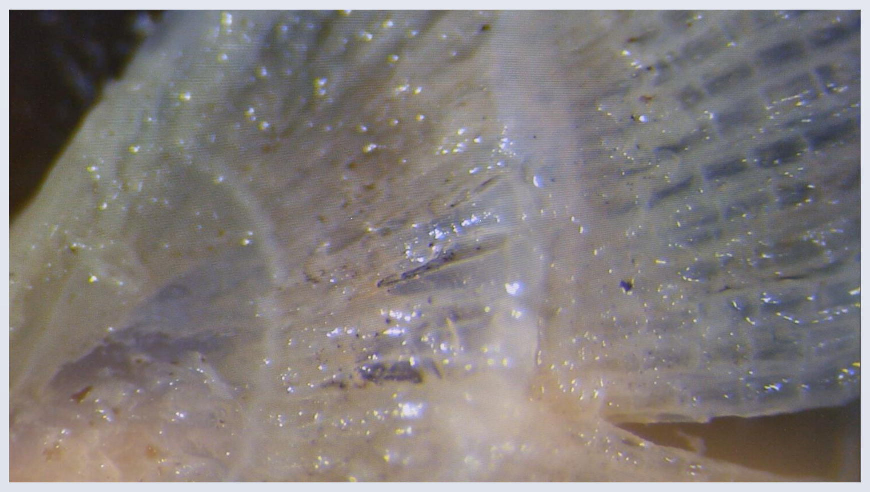
Conclusions

Hypotheses:

- Figure 1 shows that the middle of the radial bones are actively dividing while the ends of the radial bones seem to be more stable in their cellular composition. This is opposite of what we see in humans and I hypothesize that this cellular characteristic allows the radial bones to be flexible along their axis allowing flexion in these bones to occur while walking.
- Based on figure 2 I hypothesize that fish raised in an aquatic environment will see the distal parts of the radial bones fuse to allow a stronger broader surface to push against water and propel swimming, while those raised on terrestrial environments will not see the distal parts of the radial bones fuse together to allow more flexibility and maneuverability of their fins for walking.

Future directions:

- Comparing the histology between fish that solely swim and fish that solely walk to determine if there are changes in cellular structure of the fins based on the environmental conditions.



References

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