

HONOURS PROJECT

Project Title: Understanding how the nervous system forms in an ancient fish: mapping cell movement and nerve development in the elephant shark

Supervisor(s): A/Prof Catherine A Boisvert

Project: A major evolutionary innovation in jawed vertebrates is the separation of the head and trunk [1]. Whilst the development of the cartilage and muscles of the neck have been well studied [2-4], the peripheral nerve architecture has received less attention. Peripheral nerves show a distinct head and trunk differentiation in extant sharks [5] but no study so far has mapped the development of these nerves in 3D. In this project, you will characterize the development of peripheral nerves in growth series of Elephant sharks (*Callorhinchus milii*) one of the slowest evolving vertebrates [6] through immunostaining and confocal imaging (image above) and nano-CT scanning and 3D modelling. This detailed map of peripheral nerve growth and migration will contribute to understanding how the head-trunk boundary became developmentally and anatomically distinct in jawed vertebrates and flexibility in developmental integration of the nerves, muscles and skeleton that led to the morphological diversity we see in the fossil record[3]

Funding: All necessary laboratory equipment and imaging facilities are available within the School of Molecular and Life Sciences. Access to advanced microscopy platforms (confocal and light-sheet imaging) is provided through the Curtin Medical Research Institute and MOU with UWA.

Special Requirements: This is a lab-based project which will involve handling and processing of preserved *C. milii* embryos. Training will be provided in immunohistochemistry, microscopy, and 3D image analysis. Some microscopy work may require flexible scheduling depending on instrument availability

References:

1)Trinajstic, K., et al., *Exceptional preservation of organs in Devonian placoderms from the Gogo lagerstätte.* Science, 2022. **377**(6612): p. 1311-1314. 2)Johanson, Z., et al., *The Synarcual of the Little Skate, Leucoraja erinacea: Novel Development Among the Vertebrates.* Frontiers in Ecology and Evolution, 2019. **7**(12) 3) Johanson, Z., C.A. Boisvert, and K. Trinajstic, *Early vertebrates and the emergence of jaws*, in *Heads, jaws and muscle: Anatomical, functional and developmental diversity in chordate evolution*, J.M. Ziermann, R.E. Diaz Jr, and R. Diogo, Editors. 2019, Springer International Publishing: Switzerland. 4) Trinajstic, K., et al., *Fossil Musculature of the Most Primitive Jawed Vertebrates.* Science, 2013. **341**(6142): p. 160. 5) Juarez, M., et al., *Characterization of the trunk neural crest in the bamboo shark, Chiloscyllium punctatum.* Journal of Comparative Neurology, 2013. **521**(14): p. 3303-3320. 6) Venkatesh, B., et al., *Elephant shark genome provides unique insights into gnathostome evolution.* Nature, 2014. **505**(7482): p. 174-179.