Science and Technology Group
Annual Report FY2024

Ray A. Sallan DDS
Science and Technology Associate

1 Introduction

To understand the broader relationship between jaw and tooth morphological coevolution, we must first examine the environmental and conditional factors that can influence both. Tooth replacement is a process especially well illustrated in fish, providing a unique opportunity to investigate whether teeth are adaptable to feeding ecology. To explore this, I aim to understand the underlying cause of tooth replacement, if any. While many aspects of tooth replacement are well studied, what triggers these mechanisms remains poorly understood and difficult to study due to the need for long term in vivo chronological documentation. By working with the Macroevolution Unit, I am investigating potential links between tooth damage and tooth replacement rates. I believe this is a starting point for understanding evolutionary responses to feeding ecology, which may, in turn, influence broader jaw evolution.

2 Activities and Findings

The tooth replacement study is in its prep stages, the following has been accomplished in FY2024:

1. Finalized the tank set up for fish (see pictures). This includes lab equipment and lab benches, tanks, filtration system, stabilization and testing of water parameters. With the help of the engineering section, we invented and fabricated a locking mechanism for the fish tanks that eliminate the risk of fish jumping and dislodging tank covers. I have also designed the set up for quick and nearly automated water changes as larger freshwater fish produce a heavy bioload that requires weekly changes.
2. Procured fish from external suppliers. We plan to use larger 30 cm+ sizes *Polypterus endlicheri wildtype and* Snakehead *Channa aurantimaculata (Orange-spotted Snakehead)*. Although the method was published with smaller fish (12-14 cm) I feel that larger teeth samples would provide a more predictable and reproducible results due to larger teeth.
3. We have performed several sedation trials on Snakehead and Polypterus using MS222 and Clove oil, fine tuned the dosages and procedures.
4. We also performed several impression trials to modify impression tray design for 3D printing. Also performed several impression dry runs to determine time needed to perform several impressions during sedation time and also material requirements.
5. We published the method we will use to quantify tooth replacement rates. This method, outlined in *Wibisana, Sallan et al (2024)* (See FY2023 report for method description), was modified to accommodate the larger size of the Snakehead size and oral shape.

The first experimental phase (see Fig 1 below) of the project will begin this spring with control feeding, impressions and imaging.

Science and Technology Group
Annual Report FY2024

Ray A. Sallan DDS
Science and Technology Associate

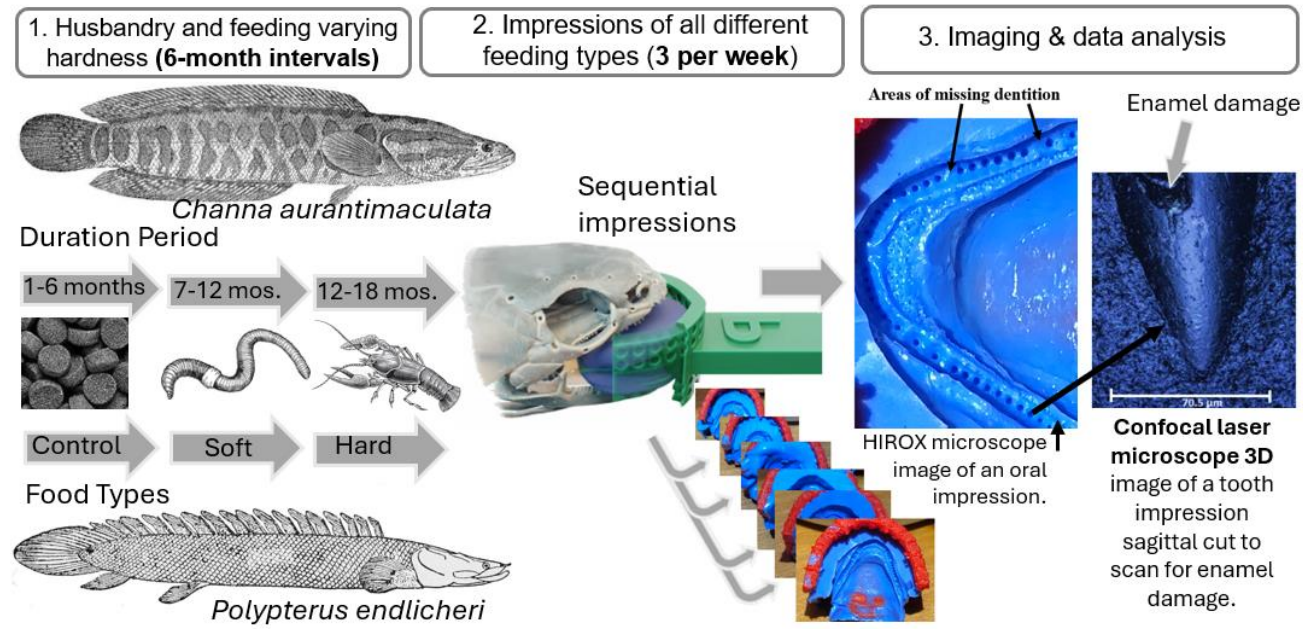

Fig. 1 Project design

Fish lab set up.

3 Current Collaborations

- Sallan Unit, OIST (Prof. Lauren Sallan)
- Johannes N. Wibisana, OIST (Sallan unit rotation student, Currently Luscombe Unit)
- Pavel Puchenkov, OIST (Scientific Computing and Data Analysis Section)
- Radmila Neiman, Research Technician

4 Publications and other output

Wibisana, J.N., **Sallan, R.A.**, Ota, T., Puchenkov, P., Kubo, T. and Sallan, L. (2024), Modifiable Clinical Dental Impression Methods to Obtain Whole-Mouth and Detailed Dental Traits From Vertebrates. Journal of Morphology, 286: e70017. https://doi.org/10.1002/jmor.70017