Science and Technology Group
Annual Report FY2025

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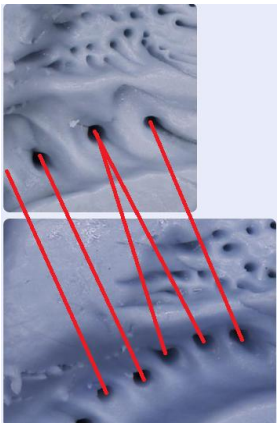
1. Introduction

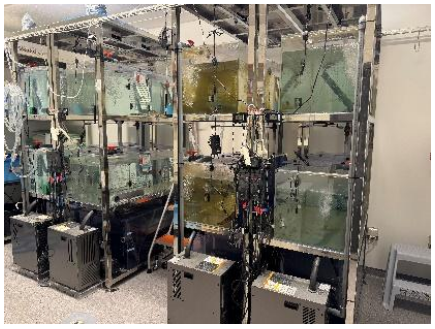
To understand the broader relationship between jaw and tooth morphological coevolution, we must first examine the environmental and physiological factors that influence both. Here, we begin by focusing on teeth and the factors governing their development and replacement. From my perspective as dentist who has been working on human diphyodont teeth for two decades, continuous tooth replacement is a novelty that I find fascinating. In contrast, fish exhibit continuous tooth replacement, providing a unique opportunity to investigate whether and how dental traits adapt to feeding ecology. To explore this, I aim to identify the underlying triggers of tooth replacement if any. Although many aspects of tooth development and replacement have been well described, the mechanisms initiating replacement remain poorly understood, largely due to the challenge of obtaining long-term, in vivo, chronological data. In collaboration with the Macroevolution Unit, I am investigating potential links between tooth damage and tooth replacement rates. This work represents an important starting point for understanding how feeding-related functional demands drive dental evolutionary responses, which may, in turn, influence broader patterns of jaw evolution.

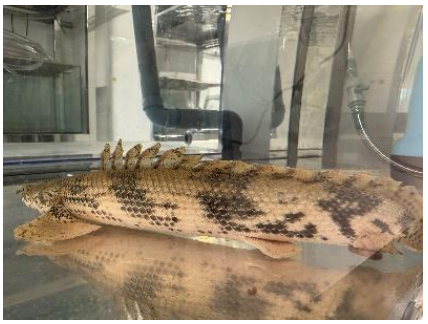
2. Activities and Findings

The tooth replacement study is currently in its second phase. The following activities and findings were completed in FY2025:

1. **System pH manipulation:**
   I tested whether system pH could be lowered using natural tannin- and humic acid–producing sources such as leaves and driftwood. I was looking for a long-term solution that would keep the system PH stable for the longevity of this experiment. This approach has been largely successful, with pH decreasing by approximately 7-10% to date.
2. **Initiation of experiment, data collection:**
   I initiated controlled feeding experiments and weekly dental impression collection following our previously published methods (Wibisana et al., 2024) (see FY2023 report for full methodological details), along with Hirox imaging and tooth annotation–based data collection.
3. **Completion of Phase 1 (control food phase):**
   I completed the first phase of the experiment, which consisted of **20 weeks of longitudinal assessment use control food feeding conditions**.
4. **Imaging and annotation progress:**
   All Phase 1 imaging has been completed, and annotation and data extraction are currently in progress. Serial datasets are being reviewed to ensure accurate longitudinal alignment. Some specimens have been re-examined and updated as additional patterns became evident. Phase 2 imaging is currently underway, and annotation will begin after the control group is completed.
5. **Initiation of Phase 2 (soft-diet experiment):**
   I began the second experimental phase (**26 weeks; expected completion in summer 2026**), which includes the design and fabrication of a novel food type that is softer on teeth and causes reduced or no dental damage while maintaining equivalent nutritional value. Multiple fabrication trials were conducted to optimize water stability and minimize animal rejection.
6. **Preparation for Phase 3 (hard-diet experiment):**
   I designed a protocol for producing a harder food type for the third phase of the project, scheduled to begin in early fall 2026. Procurement of required materials is underway, and preliminary food fabrication experiments will begin in early spring. This phase will include food fabrication and 8 weeks of feeding trials prior to the initiation of dental impression sampling.







3. Collaborations

- Sallan Unit, OIST (Prof. Lauren Sallan)
  - Chi Ngai Tang, OIST Student, (Sallan Unit)
  - Akimi Sugiyama, Research Intern, (Sallan Unit)
- Johannes N. Wibisana, OIST Student, (Luscombe Unit)
- Radmila Neiman, Research Unit Technician, (Stephens Unit)

4. Publications and other output

Kubo, T., Wibisana, J. N., **Sallan, R. A.**, and Sallan, L.
Feeding experiments with Polypterus senegalus reveal diet-related tooth damage and dental microwear.
(In revision)