

Science and Technology Group Annual Report FY2023

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1 Introduction

My research focuses on heterotrophic plants, i.e., plants that acquire at least part of their essential resources from other organisms. Heterotrophic plants include parasitic plants and mycoheterotrophic plants. Parasitic plants steal resources from other plants, while mycoheterotrophic plants steal resources from mycorrhizal fungi. I study their diversity, biology, ecophysiology, and genomics. I combine traditional ecophysiological methods with genomics to study physiology and evolution of parasitic and mycoheterotrophic plants. I mainly focus on Japanese, including Okinawan, species of various trophic strategies from partially (green) to fully heterotrophic (non-green) species.

2 Activities and Findings

I have recently focused on the genomics and transcriptomics of two unrelated lineages of fully heterotrophic plants from the Balanophoraceae and Thismiaceae families.



Fig. 1: Studied parasitic plants from the *Balanophora* genus. A: *B. japonica*; B: *B. mutinoides*; C: *B. tobiracola*; D: *B. subcupularis*; E: *B. fungosa* subsp. *fungosa*; F: *B. yakushimensis*, and G: *B. nipponica*.

Thismiaceae family. This monocotyledonous family consists exclusively of non-photosynthetic plants that are extremely rare and highly endangered due to habitat loss.

In collaboration with Dr. Filip Husnik and Dr. Kenji Suetsugu, I assembled the plastid genomes of two endemic species from the Thismiaceae family: *Relictithismia kimotsukiensis* from Kyushu and *Oxygyne shinzatoi* from Okinawa. We updated the phylogeny of the family based on plastid-encoded genes (**Fig. 2**). Additionally, I extracted RNA from these species and assembled their transcriptomes. In the next fiscal year, I plan to confirm the plastid-gene phylogeny by reconstructing the phylogeny using our transcriptomic data.

Evolution of full parasitic plants from Balanophoraceae

I have expanded our research on Balanophoraceae through a new collaboration with Dr. Huei-Jiun Su from the University of Taipei, an expert on the evolution of this family. She provided genomic data on Taiwanese *Balanophora* species. In collaboration with her, Dr. Filip Husnik and Dr. Kenji Suetsugu, we updated our analyses on Balanophoraceae, and I am currently finalizing a manuscript dedicated to this research project.

In the manuscript, we focus on twelve populations of *Balanophora* across Taiwan and Japan (**Fig. 1**). We assembled their plastid genomes and transcriptomes and inferred phylogenetic trees from their plastid-encoded and nuclear genes.

Evolution of full myco-heterotrophic plants from Thismiaceae

The second research project focuses on the evolution of extraordinary mycoheterotrophic plants from the

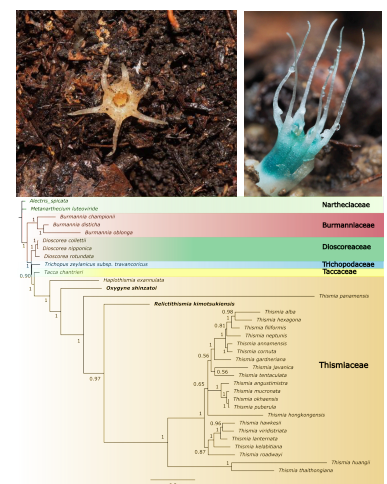


Fig. 2: *Relictithismia kimotsukiensis* and *Oxygyne shinzatoi*, two Japanese endemic non-green species from Thismiaceae studied here (top) and the updated phylogeny of the Thismiaceae family (bottom). The phylogeny is based on 20 plastid protein-coding genes and inferred by a Bayesian method. Used model: LG+I+F+G; 2,000,000

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3 Collaborations

Filip Husnik, OIST, Okinawa, Japan
Kenji Suetsugu, Kobe University, Kobe, Japan
Su Huei-Jiun, University of Taipei, Taiwan

4 Publications and other output

Conferences:

Petra Svetlikova, Filip Husnik, Kenji Suetsugu. The plastid genome of *Oxygyne shinzatoi* and the evolution of Thismiaceae. MONOCOTS VII, 7th International Conference on Comparative Biology of Monocotyledons, 11-15 March 2024, San Jose, Costa Rica. Oral presentation.

Petra Svetlikova, Kenji Suetsugu, Filip Husnik. The evolution of Balanophoraceae: holoparasitic plants with extremely reduced plastid genomes. Plant Biology 2023, 9-12 July, Braga, Portugal. Poster presentation.

Petra Svetlikova, Kenji Suetsugu, Filip Husnik. Genomics of parasitic and mycoheterotrophic plants. Joint Poster Session of OIST & ERATO Evolving Symbiosis Project Members 2023, 23 May, OIST, Okinawa, Japan. Poster presentation.