Ph.D. Candidate

**Rani Monica Shanmukha Swamy Saggere**

Graduate Academic Unit

**Biology**

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**January 18, 2022**

**1:00 p.m. (Atlantic)**

**Virtual Defence**

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**Examining Board**:
Dr. Shawn MacLellan (Biology)
Dr. Mike Duffy (Biology)
Dr. John Kershaw (Forestry and Environmental Management)
Dr. Aurora Nedelcu (Biology) Supervisor

**External Examiner**: Dr. Stephen Miller
Department of Biological Sciences
University of Maryland, Baltimore County

**The Oral Examination will be chaired by**:
Dr. Kevin Englehart, Associate Dean of Graduate Studies

## BIOGRAPHY

**Universities attended (with dates & degrees obtained):**

| | |
|---|---|
| 2018 – present | Ph.D. candidate, University of New Brunswick |
| 2014 | Integrated Masters in Biological Sciences, Bangalore University |

**Publications:**

**Saggere RMS,** Lee CW, Chan ICW, Durnford DG, AM Nedelcu. 2022. A life history trade-off gene with antagonistic pleiotropic effects on reproduction and survival in limiting environments. Proceedings of the Royal Society B 289: 20212669.

Ray A, Ray R**, Saggere RM,** G Ravikanth. 2021. Can species distribution models and molecular tools help unravel disjunct distribution of *Rhododendron arboreum*? Journal of Genetics 100(1):1-9.

**Conference Presentations:**

**Saggere RMS** and AM Nedelcu. 2021. RLS1 is a life-history trade-off gene with a role in the general acclimation response of *Chlamydomonas reinhardtii* (Digital Poster). Chlamy 2020+1. 19th International Conference on the Cell and Molecular Biology of *Chlamydomonas*. Ile des Embiez, France.

**Saggere RMS**, Cecilio VC and AM Nedelcu. 2021. The benefits, costs and genetic basis of multicellularity in an experimentally evolved multicellular alga (Talk). 27th Annual Graduate Research Conference. UNB, Fredericton, Canada.

**Saggere RMS** and AM Nedelcu. 2019. From life history trade-offs to somatic cell differentiation (Poster). Canadian Society for Ecology & Evolution Meeting. Fredericton, Canada.

**Saggere RMS** and AM Nedelcu. 2019. From life history trade-offs to somatic cell differentiation: Investigations into the adaptive and mechanistic role of *Chlamydomonas RLS1* (Talk). The 5th International *Volvox* Conference. Tokyo, Japan.

**Saggere RMS** and AM Nedelcu. 2019. The genetic basis for the evolution of division of labor in volvocine green algae (Talk). 26th Annual Graduate Research Conference. UNB, Fredericton, Canada.

**The Evolution of Multicellularity and Somatic Cell Differentiation in Volvocine Green Algae**

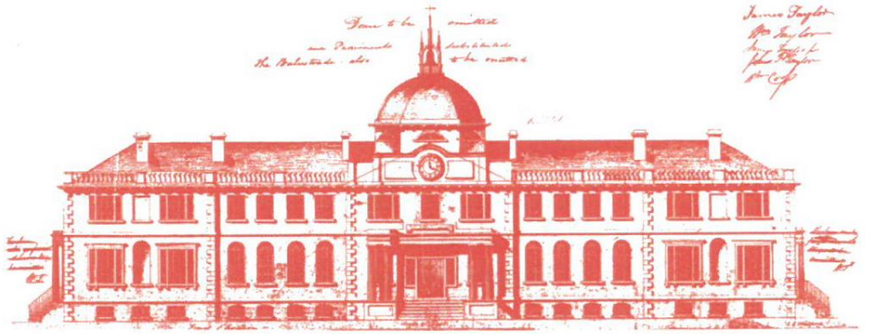

## Abstract

Multicellularity evolved independently and repeatedly in all three domains of life, suggesting that multicellular phenotypes can provide many benefits and are easy to evolve. However, complex multicellular bodies (with distinct cell types) evolved in only a handful of lineages (e.g., red, green and brown algae, land plants, animals, fungi). In complex multicellular organisms, a distinction can be made between cells involved in survival functions (somatic cells) and those specialized in reproduction (germ cells). Despite the major role that both simple and complex multicellularity played in the diversification of life, the exact fitness consequences and genetic basis for their early evolution remain unclear. The general goal of my research was to use the volvocine green algae (comprising both unicellular – such as *Chlamydomonas reinhardtii*, and multicellular – e.g., *Volvox carteri*, species) to address the following questions:

1. What are the costs and the genetic basis for the evolution of simple multicellularity in volvocine algae?

2. What is the genetic basis for the evolution of somatic cells in the volvocine lineage?

To explore the first question, I took advantage of an experimentally evolved multicellular *C. reinhardtii* strain. My data showed that the survival benefits of simple multicellularity are paralleled by costs in both reproduction and cell viability. These findings suggest that the early evolution of simple multicellularity is subjected to life history trade-offs. Furthermore, transcriptomic data from both the multicellular and unicellular *C. reinhardtii* strains suggest a novel mechanism underlying the evolution of simple multicellularity, involving the constitutive activation of a plastic multicellular phenotype. To understand the evolution of somatic cell differentiation, I investigated the adaptive and mechanistic role that *RLS1* – the homolog of the gene involved in somatic cell differentiation in *V. carteri*, has in *C. reinhardtii*. Using an RLS1 mutant and transcriptomic data, I provided direct evidence for *RLS1* acting as a life history trade-off gene that downregulates photosynthesis to increase survival, albeit at a cost to immediate reproduction. Overall, my work provided a better understanding of the genetic basis for the early evolution of both simple and complex multicellularity in the volvocine green algal lineage, including the role of stress and life history trade-offs.

*Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.*

*The University of New Brunswick recognizes that the university sits on traditional Wolastoqey territory. The river that runs right by our university – the St. John River – is also known as Wolastoq, along which live the Wolastoqiyik -- the people of the beautiful and bountiful river.*

UNIVERSITY OF NEW BRUNSWICK

# SCHOOL OF GRADUATE STUDIES

ORAL EXAMINATION


**Rani Monica Shanmukha Swamy Saggere**


IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY