Ph.D. Candidate

Juping Ji

Graduate Academic Unit

Mathematics and Statistics

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August 18, 2021

9:30 a.m. (Atlantic)

Virtual Defence

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Examining Board:
Dr. James Watmough (Mathematics and Statistics)
Dr. Guohua Yan (Mathematics and Statistics)
Dr. Myriam Barbeau (Biology)
Dr. Lin Wang (Mathematics and Statistics), Supervisor

External Examiner: Dr. Yuan Yuan
                        Department of Mathematics and Statistics
                        Memorial University

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

BIOGRAPHY

Universities attended (with dates & degrees obtained):
2017 – present   Ph.D. candidate, University of New Brunswick
2017   Master of Science, Jiangsu Normal University, China
2014   Bachelor of Science, Huaiyin Normal University, China

Publications:
G. Lin, **J. Ji**, L. Wang and J. Yu, Multitype bistability and long transients in a delayed spruce budworm population model, J. Differ. Equ., 283 (2021), 263--289.
J. Ji and L. Wang, Bifurcation and stability analysis for a nutrient-phytoplankton model with toxic effect, Discrete Contin. Dyn. Syst. Ser. S, 13 (2020), 3073--3081.
X. Wen, **J. Ji** and B. Li, Asymptotic profiles of the endemic equilibrium to a diffusive SIS epidemic model with mass action infection mechanism, J. Math. Anal. Appl., 458 (2018), 715--729.
J. Ji, B. Li and G. Zhang, Multiplicity of positive solutions to boundary blow-up problem with variable exponent and sign-changing weights, Math. Methods Appl. Sci., 40 (2017), 2057--2070.
J. Ji and C. Lei, Qualitative analysis on a reaction-diffusion nutrient-phytoplankton model with toxic effect of Holling type-II functional. Submitted
J. Ji and L. Wang, Stability and uniform persistence of an intraguild predation model with Beddington—DeAngelis functional response. Submitted
J. Ji, G. Lin and L. Wang, Effects of intraguild prey dispersal driven by intraguild predator-avoidance on species coexistence. Submitted
J. Ji, G. Lin and L. Wang, Spatiotemporal dynamics induced by intraguild predator diffusion in an intraguild predation model. Submitted

Conferences and Workshops Attended:
Borders in Public Health and Mathematical Epidemiology, October 21-25, 2019, Toronto, Canada
The 2019 Annual Meeting and Conference of the Society for Mathematical Biology, July 21-26, 2019, Montreal, Canada
The 2019 AARMS Industrial Problem Solving Workshop, July 15-19, 2019, Fredericton, Canada
The Sixth G. J. Butler International Conference on Differential Equations and Population Biology, July 23-27, 2018, Edmonton, Canada (Poster Presentation)
2018 CMS Summer Meeting, June 1-4, 2018, Fredericton, Canada (Poster Presentation)

Dynamics of Ecological Models with Intraguild Predation

Abstract

This dissertation consists of five chapters. A literature review on intraguild predation models is given in Chapter 1. For the convenience of presentation, some basic concepts and results on dynamical systems are introduced in Chapter 1 as well.

In Chapter 2, an intraguild predation model with a Beddington--DeAngelis functional response is investigated. The focus is on the existence, local and global stability of all feasible equilibria and uniform persistence of the model. Numerical simulations are performed to explore the influence of intraguild predator interference and intraguild predation on model dynamics.

In Chapter 3, we develop a novel mathematical model that couples a competition model with an intraguild predation model via dispersal of intraguild prey driven by intraguild predator-avoidance. We show that large dispersal rate would lead to the collapse of species coexistence. In addition, we show that three modes of species coexistence are possible when the intraguild prey dispersal rate is not too large.

An intraguild predation model with intraguild predator diffusion is proposed and studied in Chapter 4. It is shown that the local system can have four boundary equilibria and at most two interior equilibria. In our three-species intraguild predation model, only intraguild predator diffusion is considered. This results in a partially degenerate reaction-diffusion system. For this partially degenerate system, we show that the solution semiflow is bounded dissipative and the positive orbits of bounded sets are bounded. We also demonstrate that IG predator diffusion can lead to the occurrence of spatially nonhomogeneous oscillations and spatiotemporal chaos. Further, we show that intraguild predator diffusion can induce transitions between spatially homogeneous oscillations, spatially nonhomogeneous oscillations and chaos.

Chapter 5 summarizes the main results of this dissertation and suggests some possible future work on intraguild predation models.
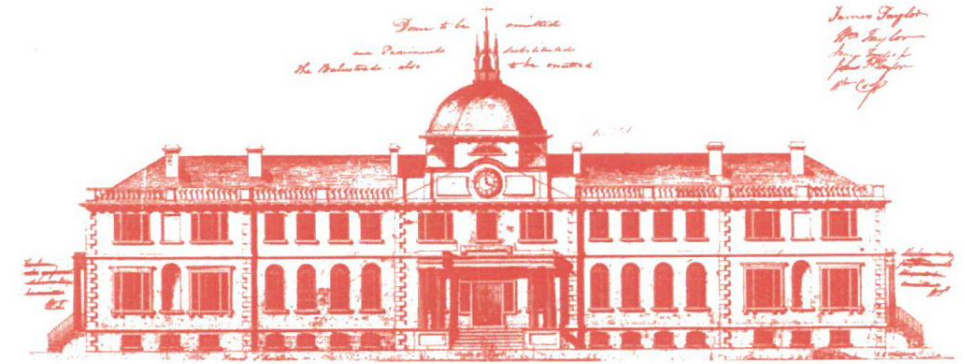
Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.

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

Juping Ji

in Partial Fulfilment of the Requirements for the Degree of

Doctor of Philosophy