Liang Xu

Department of Global Ecology
Carnegie Institution for Science at Stanford University

Email: xl0418@gmail.com
Github: xl0418.github.io

Education

- **University of Groningen** — Groningen, The Netherlands
  PhD — *Oct, 2015 - Jun, 2020*
  Theoretical Ecology and Evolution: Modelling species interactions on macroevolution and macroecology
  PhD Advisor: Prof. Rampal S. Etienne

- **University of Hong Kong** — Hong Kong, P.R.China
  Master of Philosophy — *Sep, 2008 - Aug, 2010*
  Mathematical modeling: Epidemic models of HIV infection

- **Beijing Normal University** — Beijing, P.R.China
  Bachelor — *Sep, 2004 - Jun, 2008*
  Mathematics: Mathematics and Applied Mathematics

Work Experience

- **Carnegie Institution for Science at Stanford University** — California, USA
  Postdoctoral Research Assistant — *Aug 2022 - now*
  Project: The mutual impact of biodiversity of microorganisms and nutrient cycling in oceans
  Mentor: Prof. Emily Zakem

- **Department of Biology at University of Oxford** — Oxford, UK
  Postdoctoral Research Assistant — *Jan 2021 - Jul 2022*
  Project: Competition in crisis: Investigating bias in inferring the strength of competition in plant communities
  Mentor: Prof. Lindsay Turnbull

- **Groningen Institute for Life Sciences at University of Groningen** — Groningen, NL
  PhD student — *Oct 2015 - Jun 2020*
  Project: Modelling species interactions on macroevolution and macroecology
  Mentor: Prof. Rampal Etienne

- **Chongqing University of Science & Technology** — Chongqing, P.R.China
  Lecturer in Department of Mathematics and Physics — *Jul 2010 - Sep 2015*
  Teaching courses: Calculus; Linear algebra; Differential equations; Mathematical modeling; etc.

Projects

- **Improved maximum growth-rate prediction by balancing mechanistic and phylogenetically-aware models; On-going**: Developed a method to estimate maximum growth rates of bacteria based on genomics sequences and phylogenetic relatedness between bacteria species. R package is available at https://github.com/xl0418/Phydon.
- **On the consequence of density-dependence effect: species coexist on a wide range of resource productivity; On-going**: Extending the classic resource competition theory by considering negative density-dependence in ecological interactions.
- **Increase in microbial diversity with depth emerges from a simple but general marine ecosystem model; On-going**: Developed a 1D oceanic model and explored microbial diversity changes and its effect on carbon cycling.
- **Inferring species competition from trait patterns in eco-evolutionary history**: Developed a trait-evolution model with population dynamics along phylogenetic tree branches and inferred the effect of species competition on trait evolution from phylogenetic history; Using Approximate Bayesian Computational methods infer the phylodynamics that forms the morphological patterns of species.
- **Inferring the effect of local diversity-dependence on biodiversity**: Developed hidden Markov models to describe probability of system states along phylogenetic history and investigated the effect of local diversity-dependence on biodiversity maintenance.
- **A spatial phylogenetic Janzen-Connell extension to the neutral theory of species diversity**: Developing individual-based eco-evolutionary simulation models to explore the influence of local ecological mechanisms on evolutionary community patterns.
- **Estimating competition in metacommunities: accounting for biases caused by dispersal diffusion**: Investigating the bias in estimating species interactions generated by functional form error in population growth models.

Publications

- **L. Xu**, Emily Zakem, and Jackie Lee Weissman. Phydon: Improved maximum growth-rate prediction by balancing mechanistic and phylogenetically-aware models. **In preparation**
- **L. Xu**, Christopher Klausmeier, and Emily Zakem. Coexistence and density-dependent loss in complex ecosystems. **In preparation**
- Emily J. Zakem, Jesse McNichol, J.L. Weissman, Yubin Raut, **Liang Xu**, Elisa R. Halewood, Craig A. Carlson, Stephanie Dutkiewicz, Jed A. Fuhrman, Naomi M. Levine. Predictable functional biogeography of marine microbial heterotrophs. bioRxiv, under review at a peer-review journal, **2024**.02.14.580411; doi: https://doi.org/10.1101/2024.02.14.580411
- **L. Xu**, A. Clark, M. Rees and L. Turnbull. Dispersal causes bias in estimating the strength of competition in plant communities. ***Methods in Ecology and Evolution***. **2022**. DOI: 10.1111/2041-210X.14022
- **L. Xu**, S.Van Doorn, H. Hildenbrandt, R.S. Etienne, Inferring the Effect of Species Interactions on Trait Evolution, ***Systematic Biology***, **2020** Sep; doi: 10.1093/sysbio/syaa072
- **L. Xu** & R. S. Etienne. Detecting local diversity-dependence in diversification. ***Evolution***, **2018** Jun;72(6):1294-1305. doi: 10.1111/evo.13482
- **L. Xu**, H. Hildenbrandt and R. S. Etienne. The phylogenetic Janzen-Connell effect can explain multiple macroecological and macroevolutionary patterns. Authorea. February 12, 2020. DOI: 10.22541/au.158152203.38129615
- **L. Xu**."A Functional Analytic Approach to the Power Series Solutions of an Nonlinear Differential Equations," **Asia-Pacific Power and Energy Engineering Conference**, **2012**, pp. 1-4, doi: 10.1109/APPEEC.2012.63 07563.

Mini Projects

- **Resource competition theory seminar online blog**:
  - **Developing online demonstration for seminar of resource competition theory** : A seminar organised by Prof. Chris Klausmeier from Michigan State University
  - **Website**: https://xl0418.github.io/ResourceCompetitionSeminar/
- **The government should respond quickly to prevent COVID-19 development** :
  - **An one-week Kaggle competition on COVID-19 pandemic**: A virus spread individual-based model was developed to investigate the impact of government response speed on the progression of a pandemic.
  - **Website**: https://xl0418.github.io/Kaggle_corona/
- **Data visualization: develop a Shiny app to track COVID-19 spread**:
  - **Data visualization**: A shiny app was created to display the global progression of the pandemic using data from Johns Hopkins University.
  - **Website**: https://liangxu-shinyapps.shinyapps.io/corona_shiny/
- **Plant communities simulation Shiny app**:
  - **Biology**: Simulation and parameter inference visualization of the project "Estimating competition in metacommunities" at the department of Plant Sciences, Oxford University.
  - **Website**: https://liangxu-shinyapps.shinyapps.io/PlantSimShiny/

Academic activities

- **Aug, 2024**: Oral presentation at 2024 Ecological Society of America Annual Meeting (ESA), Long Beach, CA, USA
- **Feb - April, 2024**: Resource competition theory seminar, organized by Christopher Klausmeier at Michigan State University, Seminar blog maintained by Liang Xu
- **Feb, 2024**: Oral presentation at Ocean Science Meeting (OSM), New Orleans, LA, USA
- **Aug, 2023**: Poster presentation at Ecological Society of America Annual Meeting, Portland, USA
- **Dec, 2022**: Talk at Complex Systems Colloquium, University of Oldenburg, Germany
- **Jun, 2021**: Talk at German Center for Integrative Biodiversity Research (iDiv)), Halle-Jena-Leipzig, Germany
- **Aug, 2018**: Joint Congress on Evolutionary Biology: Poster presentation, Montpellier, France
- **Mar, 2018**: The First Conference of the Netherlands Society for Evolutionary Biology (NLSEB): Poster presentation, Lunteren (Akoesticum), The Netherlands
- **Nov, 2017**: The 2017 Congress of the European Society for Evolutionary Biology: Poster presentation, Groningen, The Netherlands

Academic service

- **Associate editor**: Marine Biology; Peer Community in Ecology
- **Reviewer**: PNAS; Evolutionary Ecology; Ecological Modeling;

Public activities

- **Oct, 2022**: Public Talk on "Opening Address on Research Journey" at Chongqing BI Academy – a private K-12 international school, Chongqing, China

Teaching

- **Jan, 2021 - Jan, 2022 Oxford University**: Active leader; Teaching assistant: Research skills (4th year undergraduates); Computer skills; Advanced ecology and evolution - Stability, stationarity and perturbation in ecological and evolutionary systems (3rd year undergraduates); Ecology and Evolution (2nd year undergraduates).
- **Oct, 2015 - Jun, 2020 Groningen University**: Teaching assistant: Ecological interactions – Competition & response; Models in Life Sciences
- **Jul, 2010 - Jun, 2015 Chongqing University of Science & Technology**: Lecturer: Advanced Calculus; Matrix; Linear Algebra; Differential equations; Mathematical modeling, etc.

Programming Skills

- **R**: **Proficiency**. **Packages**: SDDD, ggradar2, Phydon. **Data visualization** via **Shiny apps**. Model simulations.
- **Python**: **Proficiency**. ABC-SMC algorithm; Deep learning algorithms; Model simulations; Fluid flow interpolation schemes.
- **Julia**: **Proficiency**. Simulation modeling.
- **Others**: Bash scripting used for large-scale data processing; High-performance computer cluster usage. More programming details can be found on my website: xl0418.github.io