

MICHIGAN STATE UNIVERSITY

October 24, 2018

Ecological/Evolutionary Theory Search Committee
Department of Biological Science
Florida State University
Tallahassee FL

Dear Search Committee:

I'm writing in enthusiastic support of **Colin Kremer** for a faculty position in your school. Colin has exceptional promise in both research and teaching and would be an excellent addition to your faculty.

I've known Colin since 2007, when he participated in a summer course in theoretical ecology that I taught. After graduating with degrees in math & biology from SUNY Geneseo, he worked with me on a research project for a year, then joined my lab as a graduate student the next year, funded by an NSF Predoctoral Fellowship. He received his Ph.D. in 2014 and began a postdoc between Yale & Princeton, supported by a highly competitive NSF Postdoctoral Research Fellowship in "Intersections of Biology and Mathematical and Physical Sciences and Engineering." Since 2017, Colin has been a postdoc with us on an NSF-funded project that he helped write (described more below).



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Colin's work addresses fundamental questions in ecology and evolutionary biology, using phytoplankton as a globally important model system. Broadly speaking, his research seeks to determine the rules that govern the dynamics and organization of ecological communities in space & time. Thermal biology has been a particular focus, given its importance for organisms & ecosystems and its relevance to global change. Colin uses both theoretical modeling techniques (nonlinear differential equation models) as well as modern statistical analysis of large-scale empirical datasets. This combination of skills is rare but extremely effective: the connection to real data grounds his work in reality and allows him to test his theory-derived hypotheses. His work is of basic interest to many ecologists, as well as directly relevant in understanding how aquatic ecosystems will respond to environmental change. Although his current work has been on plankton, he is a broad conceptual thinker. He also collaborates well with others, as evidenced by invitation to working groups and co-authorship on diverse papers where he has lent his statistical skills (*e.g.* Seltzer *et al.* 2015, Royer *et al.* 2016, Prunier *et al.* 2017).

Much of Colin's thesis research focused on the effect of temporal variability on ecosystems, an important frontier of ecological theory given the ubiquity of non-equilibrium dynamics in ecosystems. His first project in this area (published in *Journal of Theoretical Biology* in 2013) analyzed a classic model of species

coexistence in an evolutionary setting, extending methods of adaptive dynamics to incorporate environmental fluctuations. In the process he developed new analytical and numerical techniques for conducting invasion analysis in periodic environments.

His second project was in collaboration with another graduate student (Mridul Thomas), Elena Litchman and me, investigating the evolution of thermal performance of marine phytoplankton (published in *Science* in 2012). Mridul had collected temperature-response curves of many species from the literature along with where they were isolated from. Colin made two essential contributions to this project: 1) He developed an adaptive dynamics model of evolution of thermal optima, which he forced with empirically derived temperature regimes, to predict how temperature optima vary with climate. 2) He analyzed temperature-growth curves to determine the fundamental niche of each species in the modern ocean, then used future climate scenarios to project each species' distribution in 2100.

A third thesis chapter (published in *Ecology Letters* in 2017) abstracted the essence of the model from his *Science* paper to permit a more thorough theoretical exploration of how environmental variation structures ecological communities. This was a technical *tour de force* that revealed eco-evolutionary subtleties such as multiple eco-evolutionary attractors, but also yielded an intuitive rule-of-thumb to determine the diversity that can be maintained by environmental variability. It was recently chosen as the 2017 Outstanding Theory Paper by the ESA's Theoretical Ecology Section.

Since graduation, Colin has continued to investigate the role of temperature on plankton communities. His first postdoc extended his work on the evolutionary ecology of phytoplankton to much larger scales using global ocean models. He's also performed some experimental work at Yale. I'm sure his other letters will have much more to say about that work.

Recently, we (E. Litchman, T. Rynearson, D. Hutchins and I) received funding from the NSF Dimensions of Diversity program to combine field and lab experiments with models of phytoplankton thermal evolution. Colin was an absolute key contributor to this proposal at all stages from conceptualization to writing and has rejoined our lab as a postdoc on this project. If he were at our institution during the submission, he would have easily warranted co-PI status. Based on his creative thinking, ability to collaborate with empiricists, and clear writing, I have no doubt he will succeed in funding his research program when he gets a tenure-track position.

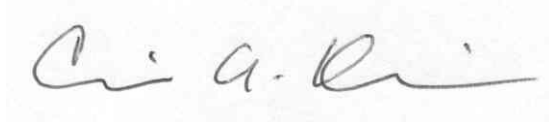
Colin is an excellent teacher. He designed and taught an intensive one-week course in maximum likelihood statistics three times as part of a summer program in mathematical ecology at KBS. Students loved him! I've also witnessed him successfully mentor a undergraduate summer project and see that he's continued working with undergraduates and high school students during his postdoc.

Furthermore, Colin was the “go-to” person for anyone with statistical problems at KBS — he generously helped a whole generation of graduate students and postdocs with their projects.

Personality-wise, Colin is friendly and easy-going. We have entrusted him with many tasks over the years — giving guest lectures, interacting with visitors, coordinating our summer mathematical ecology program, reviewing manuscripts for journals. He’s conscientious and absolutely dependable, and will make an ideal departmental colleague who takes his service responsibilities seriously.

In summary, Colin has already made significant contributions to theoretical and aquatic ecology and will become a leader in the field, as well as a great teacher and mentor. If you have any questions, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "C. Klausmeier", written on a light-colored background.

Christopher Klausmeier

MICHIGAN STATE UNIVERSITY

October 15, 2018

Dear Search Committee:

It is my great pleasure to recommend Dr. Colin Kremer for an assistant professor position in your Department. I have known Colin for eight years, was on his PhD committee (he defended his PhD in 2014) and am currently collaborating with him on an NSF-funded project that Colin helped to write; Colin is a postdoc on the project, based at Yale University. We have been collaborating closely for the last eight years, since the beginning of his PhD studies, and I am extremely impressed with Colin. He is one of the strongest, brightest and most promising young researchers in community ecology and quantitative ecology. Colin is extremely talented and has become a top-notch scientist with diverse interests and expertise, strong quantitative skills and broad ecological training. In addition to his focus on mathematical aquatic ecology, Colin has conducted field and experimental research in aquatic ecology as well. He is also an apt and passionate teacher, with an extremely engaging and accessible teaching style. He would be a great fit for this position.

Colin's dissertation dealt with competition, coexistence and evolution of species in fluctuating environments, an exciting and important topic. He focused on the eco-evolutionary responses of phytoplankton to changing temperature regimes, while developing a general theory applicable to other systems. Colin seamlessly merges ecology and evolution in a mathematical framework and has achieved significant results that give novel insights into the responses of species to variable environments. Colin is equally (superbly) skilled in dynamic modeling, including eco-evolutionary modeling approaches and statistical analyses and, on top of that, has a deep biological intuition. Colin's expertise in eco-evolutionary modeling of species responses to changing environmental conditions, especially temperature made him an ideal collaborator on the project I was developing with several other colleagues to predict phytoplankton community responses to warming. I invited Colin to contribute to conceptualizing the project and to writing the grant proposal. Colin was instrumental in crafting a successful proposal that was funded through the NSF's Dimensions of Biodiversity Program.

Colin is very creative and has the drive to tackle big, complex projects. He performs well above expectations and has often surprised me with how fast he achieved results. At the same time, he is an extremely thorough researcher with very high standards of work ethics. Colin has a talent for explaining complex topics in a very clear manner, both in his writing and in teaching. He is a very effective and engaging teacher and I have heard numerous rave reviews from students about his instruction year after year. Colin has a significant teaching experience and loves teaching. He can teach a wide range of subjects, from



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mathematical biology, aquatic ecology, general ecology to global change biology, statistics and modeling. Colin has taught students from diverse backgrounds and at different stages of their education. He is an effective teacher and mentor, who successfully ignites the curiosity and excitement about the diverse ecological, evolutionary and environmental concepts and problems in a wide range of students, from beginning undergraduate to senior graduate students.

Colin is always eager to learn new approaches, techniques and ideas. He participated in several international schools for young researchers, on the topics ranging from evolutionary ecology, adaptive dynamics to big data in biology, etc. and has already put new knowledge to work.

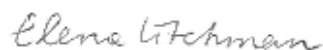
Colin is highly collaborative, interactive and enthusiastic to share his expertise, and these qualities should make him an ideal colleague and mentor. He and my former graduate student Mridul Thomas have worked together for several years looking at the patterns of thermal adaptation in marine phytoplankton. Some of the exciting results from this collaboration have been published in *Science* with both Colin and Mridul as first co-authors (Thomas, Kremer et al. *Science* 2012), *Global Ecology and Biogeography*, *Global Change Biology* and *Limnology and Oceanography*. Taken together, this body of work considerably improves our understanding of how temperature variation affects species competition and evolution. In addition, Colin's work on general theory of trait evolution in variable environments has been published in excellent journals such as *Ecology Letters* and *Journal of Theoretical Biology*.

During his postdoc at Yale and Princeton, Colin started working on merging evolutionary ecology and theoretical community ecology with oceanography to explore the eco-evolutionary responses of phytoplankton to temperature and their effects on ocean biogeochemistry. He received an NSF postdoctoral fellowship on the *Intersections of Biology and Mathematical and Physical Sciences and Engineering*, a highly prestigious and competitive award and has been applying his expertise in eco-evolutionary modeling to global ocean models and biogeochemistry in an interdisciplinary setting, working with oceanographers, mathematical modelers and ecologists at Princeton and Yale.

In addition to being a highly talented researcher and teacher, Colin is an extremely nice person. He is cheerful, witty, compassionate, helpful, reliable and fun to be around. While at KBS, Colin actively participated in many social activities and was universally liked. Colin was an essential member of the group and the MSU community and we, at KBS, wish we could hire him as an assistant professor here.

He is definitely one of the most impressive young scientists I have ever interacted with. I am also convinced he would be a great mentor and teacher who could engage students in exciting and meaningful research. Thus, he would be a great asset to your institution.

Sincerely,



Elena Litchman, MSU Foundation Professor

Yale University

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October 29th, 2018

Ecology and Evolutionary Biology Group
Florida State University

Re: Reference for Colin Kremer

To the Search Committee,

It is with great pleasure and enthusiasm that I offer my support of Colin Kremer's application for the faculty position in the Ecological and Evolutionary Theory at FSU. Colin is a creative and skilled researcher and a talented communicator. He is quite simply one of the very top young scientists I have had the opportunity of mentoring and collaborating with.

Colin joined my lab as a postdoctoral fellow in the fall of 2014, however, I first met Colin in 2010 at a workshop sponsored by the Canadian Institute for Ecology and Evolution and he and I have had ongoing interactions since that time. As Colin advanced through his dissertation work at Michigan State University, his talent for asking and addressing important questions became clear to me, and I began to actively pursue Colin for postdoctoral work. With very limited support from any of his mentors, Colin landed a highly competitive NSF Postdoctoral fellowship and came to work at Yale under the supervision Jorge Sarmiento (Princeton University) and myself. Over the past years, Colin has worked tirelessly to understand the structure of a highly complex global circulation model used by Sarmiento and collaborators at NOAA, so that the biological modules used to project primary and secondary productivity can be improved. He currently has a number of manuscripts emerging from this very challenging project. Since the fall of 2016, Colin has been primarily funded through a Dimensions of Biodiversity Grant to the Klausmeier/Litchmann labs at the University of Michigan. However, during this time, he has continued to be an integral part of my research group.

In addition to the collaborative work on the Dimensions grant, Colin is currently working to understand the importance of acclimation to thermal conditions for processes at the population and community level. Two years ago, Colin devised a novel experimental setup that would allow us to study the effects of thermal acclimation in aquatic microbes. The setup uses cast blocks of aluminum that are heated and cooled on opposite ends to create a gradient of temperatures in which cultures can be suspended. To date, and with the help of a collaborator (Sam Fey; Reed College), we have now constructed six of these "Thermal Gradient Blocks" and published our first results on the ecological importance of acclimation (Kremer et al. 2018; Proc. Roy. Soc. B). I cannot stress enough that this work, and that to come in the near future, is a production of Colin's skill, intuition, and hard work.

As an ongoing part of this work, Colin has taken the lead on pre-proposals that we wrote and submitted to NSF-DEB in 2016 and 17 as CoPIs (along with Sam Fey at Reed College). Although we have not successfully secured funding for this project to date, we were invited to the full-proposal stage once (in 2016) and will have completed a third submission of this work by the end of September 2018.

Our most recent submission includes a novel modeling framework that provides testable predictions about the mechanisms underlying the thermal acclimation patterns we have measured to date. Colin's skill in developing theory related to these experiments has closed an important gap in our proposal and we are hopeful that we will receive funding in the coming year. In all, the experience that Colin has gained by writing and submitting grants, and responding to feedback in revised submissions will give him a great edge as an early career faculty member.

Colin's recent dissertation work has generated a number of strong publications, one in the journal *Science* and more in highly ranked disciplinary journals *Ecology Letters*, *Ecology* and *Journal of Theoretical Biology*. As a person with experience in Colin's field, I can attest that his work is highly rigorous, careful, creative, and well presented. In fact, he was recently awarded the "outstanding theory paper award" from the Ecological Society of America's Theoretical Ecology section. In addition to his written work, Colin possesses excellent presentation skills; he has a naturally casual presentation style and a knack for tuning challenging concepts to a level appreciable for his audience. In 2007 he earned the Vito Volterra award for the best student presentation using theory at the Ecological Society of America (ESA) meeting. As current vice-chair of the theory section of the ESA I can attest to the high quality of candidates competing for this award each year. In 2014, Colin organized and moderated an "Ignite" session at the ESA meeting, where a handful of participants each had 5 minutes to define their view of Eco-evolutionary dynamics followed by a comprehensive discussion. The room was packed with at least 200 people and the debate was lively. Colin skillfully managed the debate and kept the various 'camps' from descending into trivial arguments. Needless to say I (and everyone else in the room) was impressed!

At various points during his tenure at Yale, Colin has lectured in undergraduate and graduate courses, demonstrating his effectiveness as an instructor. Colin delivers effective, well-paced and clearly articulated lectures that engage students very well. Additionally, he has self-initiated his own education as a teacher and mentor by participating in courses and workshops and by organizing and leading various initiatives at the Kellogg Biological Station and at Yale to educate undergraduate students and peers in various methodological and statistical tools (e.g. he has led workshops and courses on maximum likelihood methods for curve fitting). Since joining my lab, Colin has brought important insight into various ongoing projects and has taken quickly to providing guidance and assistance to the students and other postdocs in my group.

I offer my most enthusiastic support for Colin's application for a faculty position - he is the most capable and talented theoretician that I have had the opportunity to mentor and a savvy and careful experimentalist too. I would rank him among the top 1% of post-doctoral fellows that I have known during my career. I urge you to give him further consideration and allow him the opportunity to impress you in person!

Sincerely,

David Vasseur
Associate Professor
Ecology and Evolutionary Biology
Yale University