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Dear New Colleague,

I'm pleased to learn of your interest in graduate study at NC State. NCSU is a vibrant place, and offers opportunities to grow professionally and scientifically, and to indulge curiosities about the natural world. The purpose of this letter is to explain a bit about how I am able to advise graduate students, the qualifications that I look for in potential students, and my expectations for students. After reading this letter, if you are interested in pursuing graduate study here, then I hope you will contact me by email. If you do reach out, please let me know that you've read this letter.

I can advise students through three separate graduate programs: Biomathematics, Statistics, and Biology. Biomathematics is a graduate program offering three graduate degrees: a Masters in Biomathematics (MBMA), a Masters of Science (MS), and a Doctor of Philosophy (PhD). You can learn more about the program and the distinction between the MBMA and MS at the program's website. The Biomathematics Graduate Program is not housed within any one Department, but it has historically strong connections to the Departments of Statistics, Mathematics, Biological Sciences, and Applied Ecology, among others. Statistics is a graduate program that grants MS and PhD degrees, and is housed within and administered by the Department of Statistics. The Graduate Program in Biology offers MS and PhD degrees. (The URLs of the websites for these programs change with some frequency, but a Google search should take you to the right place.)

Hybrid degrees among the above programs (and others on campus) are possible. For example, it is common for PhD students in Biomathematics to consider pursuing a co-major with Biology. However, there is no mechanism by which a student can be admitted directly to a co-major; instead, a student must apply to and be admitted to a single program, and then (if desired) explore a hybrid degree after arriving on campus and beginning study.

Thus, a prospective graduate student should first consider which degree program provides the best fit. Of course, the paramount difference among the programs is that they each emphasize a different scientific expertise. In addition, though, there are other important differences among the programs that may not be apparent at first glance. In particular, graduate study in Biology follows a very different model from graduate study in any of the mathematical sciences, particularly Statistics. (This is true generally, not just at NCSU.) Biomath, as an interdisciplinary program, occupies somewhat of a middle ground between the two. Here are the implications of some of those differences.

In Statistics, graduate students apply to the graduate program, not to individual advisors. Decisions regarding admission and offers of financial support are made by a Departmental committee. After enrolling, students then focus on coursework for the first two years, and prospective PhD students must pass a comprehensive qualifying exam. Only after coursework is complete do students identify research advisors. There is not the same tradition as there is

in biology of contacting potential advisors when looking for graduate schools. That said, it is to the prospective student's benefit to browse the specialties of the faculty in the Department, and to ensure that the Department provides an appropriate fit with the applicant's research interests. If there is an advisor with whom an applicant is interested in working, there is no harm in contacting that individual before applying. A potential advisor could certainly put in a good word to the admissions committee if an applicant seems to be a particularly good fit.

Biology (and most graduate programs related to biology) operates on a different model. In Biology, prospective students essentially apply to and are admitted by labs. (Technically, admission is still by committee, but successful applicants are nearly always sponsored by a potential advisor.) Thus, for students applying to Biology programs, it is appropriate to contact a prospective advisor to inquire about whether the advisor is accepting new students.

Once admitted, a Biology degree is focused more heavily on research and less on coursework than a Statistics degree. There are course requirements in Biology, but they are fewer and more flexible than in Statistics. Of course, this doesn't prevent Biology students from taking courses as they see fit. A Biology degree emphasizes research, however, and it is expected that students will devote considerable time to identifying a research project during their first two years.

The Biomath program occupies a middle ground between Statistics and Biology. Decisions of admission and financial aid are made by committee, but that committee thinks carefully about how the applicant's research interests mesh with the research interests spanned by the faculty. Biomath PhD students also spend more time in classes during their first 2–3 years than their counterparts in Biology, although they also think about research sooner than their counterparts in Statistics. PhD students in the Biomath program are asked to identify a research advisor by the end of their first year of study if possible, and certainly no later than the end of the third semester.

There are good reasons why graduate experiences differ so much in math vs. biology — it's not just random walk to two different absorbing states. Technical skills are fundamental to the mathematical sciences, and many of those technical skills are best learned in the classroom. In biology, a different set of skills are emphasized: creativity, lateral and conceptual thinking, ability to pose and formulate an interesting scientific question, writing ability, and ingenuity, to name a few. Technical skills in biology (i.e., conducting a field experiment, constructing a phylogeny) are often best learned in the context of real research and not in a classroom.

That said, my work uses math to investigate biological phenomena, and I am best suited to advise students who are prepared to use math as well. In mathematical work, there is no substitute for technical skills. Moreover, the early years of graduate school are an ideal

moment to build technical skills. It is theoretically possible to acquire technical skills at any stage of one's professional career. However, finding the time and space to think deeply about new skills is challenging once one enters the working world. Thus, I encourage students to take the courses they need to build their technical skills, regardless of the requirements of the degree program in which they are enrolled.

A final consideration to keep in mind is that, if you are aiming for a career in academics, the name of your degree can affect the jobs for which you are eligible. For example, individuals with a PhD in Biology will probably not be eligible for faculty jobs in Statistics at some universities, even if the nature of their research is primarily statistical. (Some universities are more open-minded about this than others.) Conversely, academics are sometimes wary of hiring people with exotic degrees, such as a Biomath degree or a co-major degree. If, instead, you are interested in an industry or government job, employers are less likely to care what the title of your degree is; instead, they are more interested in the skill set that you possess.

Once you've decided to which degree program to apply, what can you expect when you are here? You will quickly find that graduate school is not as structured as undergraduate life. Opportunities for intellectual growth abound, but it may take some effort to seek out those opportunities, or to create them in the first instance. Graduate school rewards the pro-active.

I have no hard and fast rules for incoming graduate students, though I have found a few guidelines to be useful. First, as I've previously mentioned, there is no substitute for technical skills when one is doing math. You can't fake it. If the first couple years of graduate school wind up being "math boot camp", then so be it — you are establishing the foundation for decades of professional productivity. I expect all incoming advisees to have a demonstrated interest and proficiency in some sort of quantitative science, and I expect advisees to use graduate school as an opportunity to build those skills.

Second, I encourage all prospective PhD students to pursue a Masters en route to a PhD, if they don't have a Masters already. (Students arriving with a Masters in a related field likely do not need to pursue another Masters.) A Masters en route to a PhD is a nice stepping stone because it allows the advisor and advisee to work together in a research capacity before embarking on a PhD. Finishing a Masters provides an opportunity to reflect, and to change course if need be, while still having a nice product to show for the time and energy invested to that point. It's also nice to have a tangible degree in hand if unforeseen events force a PhD student to abandon their PhD research temporarily.

Third, I would like students to formulate their own research project, especially for their PhD. Again, there are disciplinary differences here. In math, it is fairly common for an advisor to define the research question for their student. In ecology (more so than in biology

as a whole), identifying an interesting research question is viewed as a key skill (perhaps *the* key skill) that one must develop and demonstrate to be worthy of a PhD. There are good reasons why the models differ so much here as well — research questions in math can be definitively answered, while the most interesting questions in ecology are the ones that are never definitively answered (which is not to say that all unanswerable questions are interesting!). I prefer to strike a balance with my students. Asking an interesting question is hard, and I want my students to practice that process. I'm not the authority on asking interesting questions, either, but I'm happy to lend my thoughts as the situation merits.

Hopefully this is enough information to get started. If you are still interested in pursuing graduate study, please don't hesitate to contact me. I'd be delighted to learn more about your interests as well.

Respectfully yours,

Kevin Gross

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