

A first draft of a memo on being a successful graduate student in ecology, at least in the Sanders Lab.
August 15, 2007

This really is a first draft of this thing that others might call a prospectus on graduate education. But that's too fancy for what this really is – just some random thoughts on what I think it takes to be successful as a graduate student. I'm sure this document will evolve over the coming years and decades, hopefully with your help. So, without further adieu, let's begin.

You're here to learn how to be an ecologist. I'm here to help you learn that. Of course, there are others here of whom you should take advantage: the rest of the faculty, postdocs, graduate students, ORNL scientists, and visiting scientists and job candidates. To be honest, when I was in graduate school, I learned more from the other graduate students than I did from the faculty about the science of ecology and the work ethic required to do good ecology. The same might be true for you. That's not to take anything away from the faculty here, but my own impression is that in talking with students over beers or coffee or in informal seminars, brilliant insights often emerge from the ether. Having said that, there are a number of things you could (and should) do to maximize your time here at UT. But keep in mind that I don't expect you to be an expert in all of these things now. Your abilities and interests and work ethic will develop.

1. Work hard. I have incredibly high expectations for all of my students, but, above all else, I expect you to work hard. For some, this might mean working 60-70 hours a week. For others, it might mean working only 50. But for everyone, it means that I expect you to be continuously engaged in your science, whether that is by reading papers, analyzing data, writing papers and proposals, or discussing ideas with other ecologists. I will say that graduate school is not a 9-5 job. In fact, you shouldn't even think of it as a job – hopefully it's your passion. In essence, you're getting some money to think about things that interest you, to spend time in the field, and to talk with interesting people about interesting ideas.

And learn self-discipline while you're working. Never say you're too busy to do something (that's one of my pet peeves). Instead, plan accordingly to ensure that you can take care of everything that needs to be taken care of. Never be in a position in which you don't have enough time to conduct a critical experiment or read an important paper.

And impressions count. You're not expected to be here from 9-5. But if you're not, you should let folks (your advisor, fellow students, collaborators, and the rest of the faculty) know that you're working. It doesn't hurt to send out a late night email or an early morning email so that people will be aware that you're working, even if you're not at your desk.

2. Read. I expect you to be well read. That means being aware of essentially all current ecology, and the important stuff from the past 30 years. You should read every current issue of Ecology, Ecology Letters, Oikos, and Oecologia. You should be aware of the relevant papers coming out in American Naturalist, Science, Nature, and PNAS. You should also read more specialized journals. If you work on insects, pay attention to Ecological Entomology. If you work on plants, the Journal of Ecology is a good journal. You should also buy and keep handy the following books: Primer of Ecological Statistics by Gotelli and Ellison and How to Do Ecology by Karban.

3. Talk. You should have a meeting with each of your committee members (not necessarily as a group) at least once a semester to discuss ideas, papers, your projects, and your future prospects. After the meeting, send the committee member an email summarizing the meeting and thanking them.

When someone asks you what you're working on, you should be able to answer in 30 seconds, 2 minutes, 15 minutes (the length of an ESA talk), and 45 minutes (the length of a departmental seminar). The answer to "what do you do" isn't "I work on ants" or that you're doing something that's never been done before. The answer always justifies your work in broad ecological terms.

You should also meet with EVERY seminar speaker who comes to EEB who is remotely ecological. There are no exceptions. You can meet with them with one or a few other people in a small meeting, or at the bar. But I require you to talk about your work with every single ecologist who visits UT.

I also require you to attend the journal clubs that are relevant to your research. Most semesters, we have a 'community ecology reading group.' You're required to go. You're also required to go to our lab meetings and present your work and papers that are related to your interests.

Present your work at national (ESA) and regional meetings. Posters are fine for preliminary results. But giving a good, enthusiastic talk is how you meet people and get good feedback.

4. Write. You will apply for every possible source of funding that you can. This isn't because we're tight on money. It's because writing takes practice, and writing proposals helps crystallize your ideas. You will also write papers that will be submitted to top tier peer-reviewed journals. For Masters students, I expect at least one robust manuscript in order to graduate. For PhD students, I expect at least three. If you're heading toward academia, the most important thing you can do is publish lots of good papers. For a master student, strive for 2-3 papers (some co-authored with others). For a PhD student, strive for 7-10 papers. To encourage you to develop these manuscripts in a timely manner, I will not sign off on a thesis until at least one major manuscript is submitted by a Masters student, and three manuscripts are submitted by a PhD student.

Good writing does not come easy. I've saved some of the first drafts of my manuscripts over the years. My advisor worked very hard to help me write clearly and concisely (I still need to work on it, though). And I will help you to learn to write clearly and concisely. But be warned – you're going to go through multiple drafts of everything you write. If you work hard to write efficiently and succinctly, I will work hard to help you. My policy is that I will get a draft back to you within 36 hours. If I don't, I owe you a beer.

5. Collaborate. I expect you to collaborate with me, with the others students in the lab, with other folks in the department and at other institutions on interesting projects. This could entail writing review papers, developing experiments, or whatever. In the lab, it will also mean that I expect us all to help one another out during big pushes – maybe someone has a huge decomp experiment that needs harvesting. Well, then we should all help.

A note about authorship: I'm pretty liberal when it comes to authorship. One of my "rules" is that anyone who thinks they should be an author on a paper probably should be an author on a paper. I'm also more likely to include someone than to exclude someone. And I don't have some rule that I'm an author on every student's paper that comes out of this lab. If we work on something together, we'll both be co-authors. If we don't, we won't both be co-authors.

6. Develop a toolkit. You're going to know how to design experiments and analyze data and think broadly and synthetically about ecology. But you should also develop a toolkit to distinguish yourself from all of the other ecologists who can do those things. Your toolkit might include modeling or null model analyses or genetic techniques or specialized statistics. Just make sure you have one, and make sure everyone knows what it is.

6. Set goals. Set goals each semester. Some of these goals should be attainable (e.g., read two books; finish manuscript). Other should be a stretch (publish four papers). Set goals each week. Set goals each day. And set goals for your entire graduate career. Write all of these goals down and keep them in a prominent place.

7. Have fun. Graduate school is fun, and ecology is even more fun. Don't hesitate to go out for a beer (I've never hesitated...). Feel free to go on a vacation every now and then. Spend time with your family, friends, and pets. Go to meetings in interesting places. And pick a project that you actually enjoy working on. Remember – ecology should be a passion, not a burden.

Some (partially edited to protect the innocent and not-so-innocent) advice from some of our very best students in EEB (Arijana Barun, Michael Collins, Greg Crutsinger, Matt Fitzpatrick, Colleen Iversen, Martin Nuñez, Lara Souza)

- Be passionate about your project, starting a project just because your advisor thinks it is a cool idea is not enough. Remember that it is Your project! If you like and are passionate about what you do, you will be likely a successful student.
- Don't be discouraged about negative feedback on your project, many people try to attack it to make it better. Criticisms is an important part of the process of constructing a solid project, be ready to receive it and to be willing to modify it, but also know that you are the person that thought more about it.
- We don't have many good courses at EEB, try to engage early in the discussion groups (book meeting, lab seminars, etc) they are a fantastic way of learning about many things.
- Try to share time with other students (lunch, beers, coffee, etc). Some people think that students learn more from other students than from their own advisors.
- EEB summer research grant is pretty cool, try to apply for it every year, it will look nice in your CV and it is one of the only easy ways to get money for research.
- Try to discuss your project with many people, and never stop looking for advice; this department is full of smart and friendly guys. People at EEB are busy but they are always willing to help you with your project.
- You don't need to discuss your project only with your committee members, many researchers that are not in your committee will be happy to discuss your project. People can be co-authors of your papers without being committee members. Try to keep you committee as small as you can. Different people have different opinions...ask students about their experience with people that you are considering having as committee members, they are easy to add but very difficult to remove.
- Placing someone on your committee is really just a formality – typically you can get help / advice from faculty without placing them on your committee. I suggest keeping the number to the minimum required by the graduate school / department. Makes getting people together easier, fewer conflicting opinions (and potentially fragile egos), and if you're a PhD, one less day of written exams during your comprehensives.
- Try to fulfill EEB expectations (comps before the third year, apply for money, publish papers), otherwise you may receive a nasty letter from the department.

- EEB and UT are a great place to learn stats and how to write papers, don't miss this opportunity.
- If you are an international student look for advice about paperwork, tax and legal things with other international students or at the I-house, people at the EEB office (and probably your advisor) are not trained on this kind of things...
- If you are TAing you will need to work many hours per week to catch up with your project (TAing + project+ classes is a lot), it is not impossible at all, but don't feel bad if you need to work on weekends.
- Talk to other faculty, students and other people in the field if you have questions (and not just your advisor) so you can make your own opinion. Most advisors like that and it exposes you to many different ideas and ways how science is done.
- Meet with committee member individually few times a year rather than just once a year with whole committee
- try to finish classes first 2 years but do not stress too much about them. Make sure that classes you are taking are classes you want and need to take. There are some requirements from the department but also lots of flexibility.
- Take only required courses and those absolutely necessary for you interests / specialty. Learn to teach yourself everything else.
- If you want to read a book talk to other grad students and you will probably find lots of others who want to read it too. Find a faculty who wants to join you and you can sign for the 600 level credit course. You need for PhD 8 credit hours of 600 level courses and they are sometimes hard to come by.
- have at least one faculty in the department whom you can approach and talk about anything (classes, research, family issues, health issues, ...). You will find that what you are struggling with lots of other people have gone through and it will not seem so difficult.
- Find the grad student who has been in the department for at least 2 years and ask them lots of questions about ins and outs of department. For example, what classes to take or not to take, what classes to TA (time consuming tedious teaching vs. learning and resume building TA-ing), who are good committee members,...
- Take time to talk to different faculty (even if they are out of your area) in the department for example: before Friday seminars, in the office, hallway,...
- Try to come up with side projects and collaborations with other grad students and faculty
- Find the time to go for a lunch or sign for a time with visiting scientists.
- Most of all remember that grad school is for long time so if you do not have fun in grad school you are going to have hard time. Do not work every single weekend, explore Knoxville and TN.
- Try to go for a beer with grad students and faculty even if you do not drink. Socializing and making contacts are critical.

- Begin a research project ASAP. Collect data and begin to DO science, not just read about it. In addition to learning the day-to-day steps involved in pursuing science (e.g., experimental design, data collection and analysis) you might find a study system or focal question for your thesis or dissertation.
- Collaborate with as many people as possible. Pick everyone's brain: fellow graduate students, professors, and scientists from other universities. Collaborations can be productive and fun. Interactions with other scientists allow you to interact with a broader community, introduce you to a wider view of the field, and create a network that you will find instrumental when you finish graduate school and apply for post-docs or professorships. Attend conferences, meet scientists, develop collaborations and build a professional and academic network. Ensure that other scientists know who you are and what you work on.
- If you don't already know, identify where you would like to be five to ten years from now. Academia? Teaching or research? How large a school? R1? Develop a tool kit that prepares you for your goal. A position at an R1 university requires a well-developed research program. Publications in respected journals are a necessity and grants are expected. For teaching, experience at the lecture level is highly desirable. Try to get this whenever possible (summer school, guest lectures, a community college). Also, consider structuring part of your graduate research to accommodate your teaching interests. Collaborate with a colleague, include a field component to learn a study system (to teach, say, ornithology), or add a chapter on some aspect of evolution in a dissertation that otherwise examines ecological questions to widen your area of expertise. Many teaching positions (probably over half) want the hire to teach either Introductory Biology or Anatomy & Physiology. If you enjoy teaching these courses, get experience with them.
- As a graduate student, you will probably learn more from your fellow graduate students than from your major advisor or other professors. Interact with them as much as possible. Graduate school offers a new group of students every year, so the ideas and discussions are always fresh. Attend a weekly reading group. Each week, ensure that you gained something from the reading group. If you don't understand the question, statistics, or a figure, ask and have it explained to you. If you think that you understood everything in the paper, try leading the discussion. Better yet, examine how this study could be applied to your research.
- **Choose a good mentor.** I see graduate school as an apprenticeship; you'll learn to be a scientist from someone who is already established in your field. Chances are the way that you approach science will be very similar to your mentor's, so make sure you choose wisely.
- **Show up.** ...and work while you're there. I work from 8 am to 5 pm, and then I go home. There are of course exceptions; an experiment to complete, homework to do, a paper or proposal to write, and generally getting stuff done, but five years is too long to feel guilty for not working all night and on weekends. If you stay focused while you're at work, you'll find you get a lot more done than half-heartedly working for 12 hours a day. And do your homework at home; you should treat graduate school like a job and not like a college class.
- **Pay attention**....to what's going on in your field, but also in the social realm that your field should be informing. You should know enough about what you do and the issues related to it to be able to clearly explain it to a future in-law to-be at a family reunion in Wisconsin (for example).

- **Do your best.** Obviously, but this includes doing something right away that you'd rather put off, like writing down your methods, working an extra hour in the field in 95 degree weather, or adding an extra replicate. You'll thank yourself later when you find it easy to write up an experiment that was elegantly done.
- **Be polite.** Always thank people (especially secretaries and technicians) for their time and energy. They don't get paid to put up with your poor attitude, and life could quickly become worse for you if they don't like you. Always send the last email in a series: "thank you", "no, thank you".
- **Don't be too attached.** After you pour your heart into a research project, it's tough to remember not to equate success with your personal identity. Don't get defensive when people question what you're doing/have done. If you don't have an answer for them, then that may mean that you've missed something important that you need to revisit. Questions about your work will (without fail) make you a better scientist.
- **Ask questions.** Speak up! Always ask a question or make a comment when you've got one. This includes classes and seminars, but is probably most important in your relationship with your advisor. A good relationship with your advisor is one that allows you to question their advice or science. You learn the most this way, and if they're confident in their abilities, they won't be defensive. Email professors or colleagues at other universities to ask what they think. This will help you broaden your ideas, and also network with other scientists.
- **Corollary: If you don't know the answer to a question, say so.** Being honest about what you do and don't know will get you the farthest towards actually knowing something. Your oral comprehensive exam is an exercise in getting you to admit what you don't know. Also, you should also trust your advisor to tell you when they don't know the answer. Quickly get rid of an advisor whom you can't trust.
- **Take advantage of the opportunities you're given.** I've found that my graduate career has been a series of opportunities for which I was in the right place at the right time. You can be lucky in the opportunities you're given, but you make the difference when you take advantage of them to the best of your abilities. Volunteer to give talks on your research. Meet with as many visiting professors and job candidates as you can (the hiring process is one of the many things you won't learn in class). But don't get sucked into volunteering for too many committees or tasks; be selfish with your time and remember that research comes first.
- **Corollary: Network, network, network (c.f. ATC).** A lot of people tend to take this very seriously and aggressively, but I find that it comes easily if you are open to discussing ideas with other people in your field, and not afraid to reach out to other universities, or ask questions. It *is* true that who you know is nearly as important as what you know in this field (especially because who you know is often related to your idea base).
- **Remember to be "old school" too.** Read the old literature. Your advisor will inevitably ask you what Kramer (1981) would say. If he doesn't, then someone on a job search committee might. Don't re-invent the wheel. Science is built on previous science, and chances are that someone had an idea similar to yours 50 years ago.
- **Be concise.** This applies to papers and proposals of course, but also to how you explain your research. You should prepare and "elevator talk" (c.f. RJN): what if your state senator is in the elevator with you? Can you express to him clearly and concisely what you do and why it is important to him in less than the 20 seconds it takes to reach the ground floor? This will of course

get easier with time, but you should really concentrate on precisely defining what you do—this will also help focus your research questions.

- **Apply for funding.** I know, an obvious and boring statement, but probably the most important thing you'll ever do. Don't just apply for EEB grants, but for as many fellowships as you think you honestly have a chance of receiving. This will also help to develop your writing skills. GREBE has recently developed a list of fellowships. Check it out on our website, and add to it.
- I took 537-538, and Multivariate, which turned out to be fairly useful. Also, don't forget about the Ag Campus—they often have many applied classes that might be useful to your field. Take your comprehensive exams in the fall of your third year; your dissertation proposal will also be “due” at this time.
- To purchase things on your own make sure you don't spend more than \$200 at a time, your name is on the receipt along with your purchase. These will go to Phyllis in the office preferably all together in a folder with the account number on them. The office will notify you when your reimbursement check comes (3-6 weeks).
- To get re-embursed for food if you go out with a speaker/job candidate make sure there is an itemized list of ALL food that was ordered and then names of EVERYONE that participated. Sunspot, Tomato Head, and several other restaurants direct bill. Preferably you eat at one of these. I have had MULTIPLE receipts denied after turning them in resulting in an out-of-pocket loss.
- **Oak Ridge.** ORNL is a great resource and worth the trouble to obtain a badge to do research out there. It is under used by students and faculty alike, which is a shame as once you tap into the system everyone is VERY helpful.
- **Grants.** Apply for them all. GREBE website has a list.
- **Lab Supplies.** Communal lab supplies versus personal for particular projects. I guess this is like living with lots of people and having one fridge. If you don't want someone to eat your food (i.e. use your stuff) put your name in Sharpie on it and set it aside. Otherwise it's likely up for grabs or to be lost.
- **Lab etiquette.** Clean up your messes, especially food and coffee please! Wear headphones when playing music and talk on the phone away from everyone else. If the recycling bin is full, then empty it down the hall. If undergrads are working for you, please instruct them as to how the lab functions. Show up to lab meetings.
- **Books to help.** Getting What You Came For...should be mandatory for all incoming students.
- **Interacting with faculty.** It is important to be somewhat social with the faculty so they know you, know what you're working on, and you know who you want (or don't want) on your committee. Go out for beers after seminar, go to dinners and parties. Just go to enough that folks know you and don't consider you part of the dark side (i.e. students you never see and thus don't care about...who the hell is Scott Duke-Sylvester?). Don't sleep with any of the faculty. In fact, I recommend NOT dating within the department for the first year at least.
- **GREBE.** Go to all the meetings, make sure you always vote on everything (especially job candidates), go to all the job candidate lunches that are relevant. Only volunteer for small things

(like potlucks or host parties). Nate forbids becoming any kind of leader in GREBE for the first 3 years of a PhD and after hopefully you avoid such things.

- **Classes.** For Stats: Schmidhammer is the best for Intro Stats (537 and 538). I recommend taking these your first year to get them out of the way. For multivariate, take Seaver the next year. All other courses are standard. Fordyce's Plant-Animal Interactions class is really good. Nate's Community Ecology.
- **Projects.** Get started right away upon first arriving. In the fall, go into the field, collect ANY kind of preliminary data, READ, READ, READ (Ecology, Ecol. Letters, TREE, Science, Nature, etc). Look at the web pages of people whose papers that you like. Meet with faculty and senior grad students to discuss your ideas. Apply for any kind of fellowship that makes you write out and develop your ideas. Look through recent NSF grants online and see what kinds of research are being funded and are fundable.
- **TA'ing.** Most likely folks are teaching Intro Bio labs. Ask senior grad students for their quizzes, syllabus, and notes and just tweak them accordingly to your own style. Try not to grade lab notebooks OR do the skull project if this is still an exercise. This will make prep time dramatically less. Make rules from the beginning about cell phones in lab, when they can leave the lab, how you grade, how they can keep track of their grade, sleeping in class, etc....This will help you from answering all the same questions every week. Don't be a hard-ass TA. It's not worth your time and is annoying for the other TA's. Just get done what needs done and make sure the students know the material.
- **Helpful Tip:** Devote 1 hour and a Power Point presentation to all the opportunities available to gain research experience either in labs here on campus or summer REU programs. These students know NOTHING about these or how to apply for them.
- **Venting and frustration.** When you are pissed, be careful who you vent to and who else is around, the department is small and people talk. Preferably vent to someone else in your lab or to your advisor or even better, your friends who live far away and have nothing to do with ecology.
- Many of the students work out at the gym or YMCA or mountain bike, rock climb, etc.... This is a good thing for your brain and body, but know when it's becoming a distraction not just for health. For example, I wouldn't recommend taking off for a week-long rafting trip if you're in the middle of your field season and could be collecting much-needed data. This is NOT a 9-5 job, 5 days a week. You should be working at least 60 hours a week and more during the busy times. Coming in at noon and working until 5pm is not going to cut it if you want to succeed or at least your advisor to think you are succeeding.
- **Open communication:** keep your committee informed of your progress. this will prevent one having to redo work. remember that your time is very valuable.
- **collaboration:** collaborate with either committee members, other grad students, or undergrads. mentoring undergrads, in particular, is a great experience to have.
- **present your work:** use the grebe symposium, sandy's seminar series, and/or lab group meetings to present your work.
- **feedback:** share and discuss your ideas with others. sometimes informal interactions (over beers) can be instrumental towards one's progress.

- **Courses:** take moderate number of courses per semester (in order to read, analyse data and write). becoming the expert in your field takes a lot of time. I would not recommend more than 6 credit hours.
- **funding:** apply for grants and fellowships. the application process often requires a research proposal which will force you to think about your questions and approaches.
- Keep in mind that you CAN do all the things listed throughout this document – if not, you wouldn't have gotten into this department in the first place. You will have successes, but probably more failures (at first for sure). Remember why you're here and keep your eye on the prize. Grad school is as much about learning to play the game as it is about learning a specific craft & the secret to success is perseverance and hard work.
- It won't be long before you are the expert in your little chunk of ecology – so learn to trust yourself and your own thoughts and feelings. Remember that advice is often just that – someone else's opinion, perhaps off the top of their head. In contrast, perhaps you've spent hours studying and thinking about the problem. I got a lot of questionable advice early on that I spent A LOT of (wasted) time worrying about. In hindsight, I should have trusted my gut.
- Take advantage of library express – its free and convenient. The library will deliver & pick up any book / bounded journal you request.
- **BACK UP YOUR DATA** and store it away from your desk. During my three years, I've learned of two computers that were stolen and 3 that experienced hard drive failures. Your time is too valuable to lose days/weeks/months/years (gulp) of work.