

A second draft of a memo on being a successful graduate student in ecology, at least in the Sanders Lab.

August 14, 2010

This really is a draft of something 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. As long as you are being productive, no one will wonder what you're up to or why you're not in the field or at your desk all of the time.

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 four. 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.

Advice from some of our very best students

(This advice has been only slightly edited from what current and former students have sent me).

Big conferences (e.g. ESA) are not always the best. Smaller and more specialized meetings can give you more visibility and make it easier to meet and interact with established scientists in your field. I try to go to one major conference (e.g. ESA) and one more specialized (e.g., International Biogeography Society, IUSSI) each year.

As a grad student I spent too much time thinking about which system I would work in and with what organisms. Really, the first thing to figure out is what area of Ecology you are interested in, which questions you are excited about and whether your questions have been asked 100 times before or not.

When applying for grants, don't hesitate to ask more advanced grad students for copies of successful grant applications and proposals. These will give you a model to follow and will increase your chance of getting funding. Different funding agencies, or even different grants within a given funding agency, vary in the formats and contents of their proposals. Guidelines help, but a good example helps even more.

You should use your adviser and other faculty members as much as you can especially while you are in the stage of developing your ideas. That said, they will be more helpful if you have a clear idea of what exactly you need from them before you step in their office. This means, show up prepared to your meetings with your committee and your adviser and you will get so much more out of them.

Find a good balance between life and work. You are expected to work hard and get papers published, but that doesn't mean you should never get out of the lab. I found that I was much more efficient at doing my research when I took one day per week to chill out and go to the smokies than when I tried to work non-stop. It's all about being smart in the way you organize your time and prioritize things you do.

Good research programs must fit into both of two molds: (1) your body of work must resemble a coherent string of studies on a general, broad EEB theme, and (2) your research program needs to

be made up of modular doable subunits. The former is important for developing your cover letters and research statements, the later is important for graduating

When you choose your committee, put the premium on personality type. Most faculty in EEB have enough expertise to be valuable on a committee. Not every faculty member will be a good fit for your personality type. Also, try to construct a committee that gets along well. If you're not sure who gets along well with who, ask around. A committee meeting spent playing out departmental cold wars is never helpful."

Be disciplined about working on a set schedule. Come in every morning at the same time and leave at the same time in the afternoon (or stay a little late sometimes).

Keep a running to-do list on your desk and make the things on it small so that you can accomplish several in one day. Add things to the list as they come up and cross them off as you accomplish them. These should be things like, "run an ANOVA on the ant1 dataset" and "edit abstract for Con Bio manuscript".

At the beginning of every semester, write a to-do list of big projects for the semester and post it somewhere where you can see it. Give yourself deadlines for each project so they don't stack up at the end of the semester. These should be things like "Submit Formica paper – Oct 15", "Apply for NSF – Nov 9" and "id all ants from summer – Dec 1".

Create blocks of time where you don't allow yourself to use the internet. If you come in at 8:30am, perhaps give yourself 30 minutes to check email, etc, then from 9am to 10am force yourself to write, do some analysis, read, etc, but do not allow yourself to check your email or look something up on the internet during this time block. It's amazing how much time is wasted on the internet.

Immediately after reading an article, enter it into endnote and write up two to three sentences summarizing the major findings of the paper into a running word document. Create categories so that you can easily find papers relating to a specific topic, for example: "ant thermal tolerance" or "nocturnal insect foraging". This document can be helpful when studying for comps or writing papers by allowing you to quickly identify the literature you've read on a particular topic.

Applying for grants is a great brainstorming measure. Nate already mentioned that applying for funding helps you crystallize your ideas, but I'd just like to emphasize it. I kept hoping an idea would pop into my head, but it wasn't until I needed to write 2 pages for a NSF grant that I was finally able to get somewhere with my brainstorming. Also, it's sometimes easier to express your thoughts to others in a written, rather than verbal, format. Once you've got something written down then you can start sharing it with others and build upon that.

Don't forget about the "other" grants! Applying for the common grants (NSF, EPA, DOE, etc) is always a must, but don't just stop there. There is money out there from a variety of sources (Nate does a great job emailing around potential offers when he hears of them) and it never hurts to send in an application. I got funded for a year from a source no one else in EEB seemed to know much about!

Ask other Graduate students about how to get things done! There are many protocols and rules at UT (outside of the EEB department) that graduate students are expected to know about and follow. Yet, most of them are either not written anywhere, or, even better, are written in various

school documents but what's written conflicts! The key thing to know is that no one knows how to do everything. Chances are, at some point, you will need (or be expected) to do something (hook up your computer to the lab printer, change your address with the school, get your vol-card from the sketch office under the stadium) and you will have no idea how to do it. I've found that the best bet is to start asking other graduate students what you need to do. If your lab mates don't know, keep asking around because you'll probably find someone who's had the same problem before.

The CORE. Although it may seem that the CORE is some form of age-old EEB torture ceremony, in reality it's only been around for 2 years. And, like most new things, it's still got some kinks to work out. Some people will tell you it was a waste of time. That being said, the first rule of the CORE is to let the faculty know how you feel. Because they don't want to waste your time any more than you do (and, I think, most are up for constructive criticism on what's going on in the course). Second, the CORE will be a lot of work. You will be expected to read a lot of papers for the class and contribute to class discussion. Some of the papers will take careful reading and it can be frustrating to read 100 pages on a topic that doesn't fit into your EEB "niche". But, approach the class with an open mind because there are some positive aspects to the class: in general, being aware of emerging topics in EEB is a good thing- it will lay a foundation for chatting with seminar speakers, visiting guests, or other conference attendees. Who knows, you might even find something relevant to your own work! Also, CORE provides you an idea of what's going on in the rest of the department (i.e. what other faculty and grad students are studying). Finally, CORE is a great way to meet and get to know all the faculty, and, most importantly will allow you to bond with your fellow cohort members who also hated reading whatever gazillion pages were assigned to you over some holiday weekend.

Schedule weekly (or at least monthly) meetings with your advisor, even if just to talk for a few minutes. In most, or all, of these meetings, ask explicitly what s/he thinks you are doing well at, and what could use improvement.

Writing can be hard, but putting it off doesn't help anything. Set aside a certain time, every week, that you always spend writing – no matter how much you may not want to.

Sometime side projects can be tempting in your first year, before your research gets really involved. Try to avoid them unless your advisor thinks it is a good opportunity.

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.

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.

Try to discuss your project with many people, and never stop looking for advice; this department is full of smart and friendly people. 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 your 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.

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.

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.

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,...

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.

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 re-embursement 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 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.

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 you 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.