JOB QUEST IN ECOLOGY AND EVOLUTION

This packet was compiled by Anurag Agrawal. Jennifer Thaler, Nora Underwood, and Helen Rodd donated their compiled packets, with the comments and input from Rick Karban, John Thompson, Dan Doak, Peter Kareiva, Spencer Barrett, Chris Eckert, Locke Rowe, Margaret Ptacek, Judy Stamps, Joe Travis, Sharon Strauss and many others.

The contents are completely skewed towards the quest of obtaining an academic position at a research university and are probably incomplete and inaccurate if you are seeking other types of positions.

Contents

Graduate school advice that will help you get there

1 Be persistent with your research. Many of your papers will get rejected (some may get rejected several times). Don't let this discourage you, it happens to most everyone. Take the reviewers comments for what they are worth, some will be serious comments, some will be misreading on the part of the reviewers, and some will simply be the reviewers being impatient jerks. A rejection from a journal is not a reflection on you or the science. Be persistent. If you think you can adequately address the criticisms raised by the reviewers, it is okay to call or e-mail the editor (be nice) and ask if s/he'd consider another look (explain your issues).

2 Sell yourself high. This means sending your work to the best journals. This also means a higher probability of rejection. However, the best journals will never publish your work unless you send it to them. Model your papers after papers on similar topics in those journals.

3 Give talks-- two a year at national/international meetings once you have data.

4 Invite seminar speakers to your campus. Think of potential post-doc advisors and invite them.

5 Learn the academic industry: how to review papers, grants, etc. ask your major professor about this and have him/her to let you in on reviews etc.

6 Do collaborative projects with students and faculty who aren't in your lab.

7 Do side projects not directly linked to your thesis which expand your breadth, but don't spread yourself too thin.

8 BUT, the most important thing you will take with you to a job interview is a solid 45 minute talk that is a cohesive, complete story. Thus, above all else, some of your research projects must converge on a story that does not require jumping around or switching gears!

9 Publish in the general journals (Ecology, Evolution) but also in the specialized journals corresponding to what you want to be: entomology journals if you want to be an entomologist, conservation journals if you want a conservation biology position.

10 Write a review/synthesis paper—these are hard to get published as graduate students because nobody knows us, but you often will have all the current papers in an emerging area of ecology/evolution because of your dissertation project--- put them together and write a review.

11 Use the "scan-doc" function from the library to keep up on the literature in your field. This will send you the latest articles based on your search criteria (author name, key word, title word, etc) every week (including abstracts in Biosis). There are also a ton of journals on line, and free.

12 Do something so that you can say you taught your own course—even if the pay is non-existent. Look into doing a hybrid seminar course where you give 10 lectures and have 20 hours of discussion (or whatever)--- this will be a lot less work than a real lecture course, but is more than a seminar--- you will get credit later on in the process for teaching a course yourself.

13 Publish soon. Try and have a good paper submitted every year starting as early as you can, but not later than your third year.

Recommended stuff:

Peters, Robert L. Getting what you came for: the smart student's guide to earning a Master's or a Ph.D. New York: Noonday Press, 1997.

Mack, R. N. 1986. Writing with precision, clarity, and economy. Bulletin of the Ecological Society of America 67: 31-35.

Writing a CV

Keep it short, concise, without jargon, with the important stuff up first, memorable, and like a list of sound-bites. Do not include the small insignificant stuff: published abstracts, meeting presentations (but include invited talks—some people say it is okay, even good, to include meeting presentations on a first cv, or one where you don't have invited talks). Padding only loses people, it does not help. Make it readable by including headings in bold and extra spaces and gutters.

The first page should include the standard stuff on addresses, education, etc. The three things that really matter go next: grants, publications, and real teaching experience. Separate the real publications from non-refereed stuff (have three categories: 1) papers- including things in press, 2) book chapters and non-refereed stuff, and 3) submitted papers). Don't include "in prep" stuff—we all know that these can be a big fantasy. Include that you have been a TA, but emphasize any real teaching experience. Make sure the real stuff sticks out… if you want to include stuff on society memberships, service, etc. put it at the very end of the CV.

Include grants that you wrote that you weren't a PI on (if this is the case, be sure one of your letter writers puts that fact that you wrote XX% of the grant and that it is your work. This will impress people, it will give credit where it is due, and also it will verify that you deserve to put the grant on your cv). Give dollar amounts for all the grants.

Possible organization: 1) education, 2) positions, 3) grants (list small ones too, but highlight or separate big ones), 4) publications, 5) teaching, 6) awards, 7) invited talks, 8) reviewers for…, 9) other small stuff.

When to think about applying

Start thinking about it a full year before you graduate. It is probably a good idea to start going through the process even if you definitely want to do a post-doc. You only need one paper out, and a couple in the pipeline to get a job.

The general timeline is: 1) Job advertisements go out from August through December (most of them in September, October and November), application deadlines are from early September through March (most of them by February 1st), interviews are from October through April (most of them November though March).

Things to get you going: Start working on your CV, statements of research and teaching, and buy some nice clothes. Sign up for the Science Magazine e-mail list at the web site: www.sciencemag.org. Go to the "careers" link, then to the "job alert" link.... input all of your information... email address, what sort of positions, include ecology, evolution, and whatever (this may all be under life sciences). Anyway, when you are done with this you will get a list e-mailed to you every week... you can then go to the specific sites for more details if the jobs sounds good for you. Nature has a similar site (www.nature.com) but will not mail you a list (i.e., you have to check every week)—almost all major jobs are advertised in both.

In a good year there may be up to 50 jobs in ecology/evolution (1997-1999 have been the best in a while… in a bad year there may be 10-20 jobs). Due to a wave of retirements, the prognosis is good for the next 5-10 years.

A lot of entomology jobs or jobs in other potentially more specialized fields are often not advertised in the weekly science journals… look for these in society bulletins and on department bulletin boards.

The application process

It takes a lot of time to apply for jobs. Do not expect to get almost anything else done during the months that you are getting your stuff together and sending it in—if you get interviews, don't expect do anything else then either!

It is worth applying for jobs if they are close to your research area, even if you don't really fit…(as long as it is a job that you feel you may end up wanting to take). At Davis a ecologist that had done one project involving insects was hired for a mosquito position in the entomology department--- At Berkeley, an ecologist who studies host-parasite theory and empirical examples was hired for a vertebrate ecologist position. I interviewed for a conservation biology position. Once you get an interview—you have the potential to be on an even playing field and the department might not know what they really want when they advertise. If you do not exactly fit the description, you may have to convince some people about why you do fit—or how you intend to fit.

There will be 50-250 applicants for the jobs you apply for. It is surprising, in that some of the bigger more well known universities will get few applications and smaller ones will get more depending on how the ad is written.

You've got to be concise and highlight your strengths. Your statements should be no longer than a page. If you have papers out, send reprints with all of your applications, whether they ask for them or not. Tailor your statements and letter to the particular job… (but don't sell yourself as somebody your not).

Cover letter: Keep it short (under a page)— make it easy for them to put a label on you. Highlight your major achievements (grants from NSF or other major agency, major publication in…). Say why you fit in, what you are excited about, where you are going, etc.

Statements: Don't be bland, don't be long winded, emphasize the future, sound excited, sound broad, but not too broad, make sure they know you have been doing some really meaty stuff in at least one area. Play your strengths, and don't try to be somebody you are not (if they like you and you don't fit the job description you may still get an interview). Use phrases such as "I plan to" – not "I hope" … use "in my laboratory I will"…

Letters of reference: You need 3 for most jobs and 4 for some. These are pretty important and should be strong letters from people that you know well. It helps if the people reading the letters know the people writing them. Since your letter writers will be writing many many letters for you, it is nice to give them a sheet with the addresses of the places you are applying and also attach the job ad. Since the season lasts a couple of months, you could give your letter writers such a sheet every two weeks. Give your letter writers enough time to write the letters—some people will tailor each letter to each job—others will not.

The structure of the interview

You will get a call, usually from the search chair. They will want you to come in about 2 weeks time. The interviews are usually 1 ½ to 2 days. Don't do a horrendous flight… if you or they are making the arrangements, don't be too shy about saying that a flight with 3 connections is not for you… Some universities will pay $2000 to fly you out, others will ask you to stay a Saturday night to get the $500 fare down to $450. It is okay to say you want the better flight. You will have almost all of your meals with people (faculty). Students will take you to lunch or have it with you in a conference room on the second day. Your talk will probably be on day 1, at 4pm. You will meet with the deans at some point. You may have some, all, or no group interviews--- although you will probably at least meet once with the entire search committee. After dinner at a restaurant on the first day, there will often be an open-house at one of the search committee member's houses. In all you will essentially have ½ - 1 hour meetings continuously from 8:00 in the morning to 8:00 in the evening for the two days. It's an endurance test.

General interview advice

1. Before you go—talk to people at your home university and other folks about the place you are visiting, who they know there, etc. This will help a lot and give you a feel for the place. If you know graduate students, post-docs, or even faculty there—call them up, email them, whatever- it is not inappropriate.
2. Read a few abstracts of the people's work. Nobody is going to grill you on it but it makes it easier to have a conversation. You can keep these in the folder you will be carrying around with you (to glance at between meetings).
3. Most of the time will be spent in idle chit chat. You have to aggressively sell yourself, because only a few people will actually ask you the important questions. Avoid conversations that do not leave an impression.
4. You must have a future directions spiel practiced. This is the only question that I was asked at all of the schools.
5. Act like the normal person that you are. They are looking for a colleague whom they can talk to.
6. Have a list of questions and ask them of everybody who is appropriate. Don't worry about asking the same question several times – YOU HAVE TO DO THIS!, it's better than silence and people may give you different answers (it's fun to hear the different answers!).
7. Don't talk about salary or figures for startup. You should have a list of a few big items that you will need (growth chambers, scopes, molecular equipment) to give them an idea of the type of lab that you will set up (only if they ask). If they bring up figures just nod and say you'd like to talk about that stuff when you have an offer.
8. Act like you care about teaching, even if you haven't done much.
9. Remember that you are on the interview because you love doing science.
10. There are often a few departmentally recognized jerks, don't worry about them. Just keep your cool, they come across as the idiot, not you. The most important thing here is to not get riled up by their questions: "I have heard nothing new from you—you evolutionary biologists have been saying the same thing for the past 30 years; where is the beef?"
11. Ask for bathroom breaks when you need them. Or if you are left to yourself for a few minutes, take them yourself…. Nobody will be wondering where you are. Use this as a time to look at your notes of questions to ask, thing to bring up, etc. Also sip some water and relax for a few minutes!
12. Have child-like enthusiasm… say you like the town, and have been liking what you have been seeing.
13. Say your "thank you"s for getting picked up, taken out to dinner etc.
14. Give search chair an updated CV if you have had papers accepted, grants funded, etc.
15. The correct answer is usually yes: when asked if you want to go out for a beer, stop by the house and meet their family, etc. etc… Obviously don't compromise your principles, but if you say no, people will remind you that you said no for your whole interview.

16. Give your talk in 45 minutes--- allow lots of time for questions--- nobody ever complains about a talk being too short unless it is thin or less then 35 minutes.
17. Remember that you are interviewing them too--- this means you should ask about things that are important to you and also that you should have an opinion about things and not just seem like a yes-person.
18. Carry some Tylenol or Advil and a hanky—it can be really useful at 3pm if you've got a headache.
19. If you tend to get hungry, carry a snack! You may find it hard to eat during lunch if people are firing questions on you… and this is not a time to get it all over the place.
20. Do not negotiate anything on the interview--- you can observe, take notes of what you like and don't like, but save the negotiating. Sometimes people will try and bait you—don't take the bait.
21. Go in with some sort of course outline, even if it is only in your head. Be sure to have ideas about potential labs that you could run, and how and why they would work and teach the students.
22. Have an idea about a philosophy of teaching (i.e., wanting the students to learn, not regurgitate, and how you do that, etc., how you feel about mentoring graduate students).
23. Think about local projects and learn a little bit about the local biota.
24. Ask to see the space that you would occupy.

Specific advice

What to wear and bring: You've got to be comfortable, but dress well. Formal suits are overkill and may be perceived as weird. A tie is optional for men, but is recommended, especially in the south or at other more formal places. Have nice comfortable shoes, they don't have to be fancy. It is good to stand out a bit when you are walking in the halls on your interview. Dress cleanly and simple, blue and white shirts, simple navy jackets, etc. work well. You must bring a folder to keep your schedule and some notes. A good thing to keep in the folder is a copy of questions you would like to ask—refresh you memory on breaks and free time. This will also give you a place to stuff reprints that people you interview will shove on you (because you are SO interested in their work).

Talking to the dean: The deans have to meet with you (usually it is a small dean, or dean-let). They often don't know what to say to you, and make small talk. They don't get a vote (occasionally they get a veto, though). Be prepared to have stuff to say, but also take a break when you are with the deans. You can talk about big stuff—wanting to work on training grants, where s/he sees the department is going, new positions, etc. No need to pay attention to the stuff about retirement plans. This meeting is potentially very important if you are interested in negotiating something big—like a spousal position… the dean can make it happen. Don't bring it up at this point, just make a great and lasting impression.

Talking to graduate students: This does count. Ask them what they do, they will probably go around the room. Ask them questions about their projects, or refer to how your work, or work you are familiar with fits in. Ask them what they want, what is missing in the department. Feel free to joke a bit with the department, they will love it if they can identify with you. Talk about professional development for graduate students, and how you would like to run seminars or workshops on this--- as a young person that is something you can bring to the department that is often missing, and it is something that graduate students often like and need. As it is generally the case that the graduate students are the movers and shakers of a department, how good they are and how enthusiastic they are is likely to be a good indicator of the health of the department.

Your talk: It will often be at the dead time of the day: 4pm. Ask for a glass of water before hand. If you don't like laser pointers, don't use one. Say thanks for the invitation and tell them that you have been having a great time. Know your talk by heart, and don't use notes. State the broad interesting issues and questions. Be sure to also state your specific question very clearly. Have an outline so everybody knows where you are going. Don't switch gears—weave a complete story that is all tied together. Drop hints regarding the statistics used, but don't give too many details. End with a punchy statement with the punch-line—not with caveats, or what you wish you could have done. The introduction can be 10-15 minutes. Many of the research talks you give will be used to determine your teaching ability. The best talks are 45 minutes. Remember to know your audience: Are you talking to a biology department, an evolution and ecology audience? Be broad, avoid jargon and explain things that you may think everybody should know (e.g., trophic cascades)… make it accessible to all biologists.

Teaching talks: Many places will have you give a teaching talk—they may give you a topic or let you choose one from a list. Some will want a sample lecture—others may actually want a verbal statement of your teaching philosophy. In general, ask those around you that actually teach those subjects for outlines or notes. It is usually fine to have notes for your teaching talk. They will probably ask you to not use slides, but overheads and handouts may be very useful. The faculty may interrupt you during your talk and pretend to be students asking questions. Try not to get flustered by them, but rather have fun with them.

Questions you WILL be asked: prepare answers!

What research will you do when you get here/in the next 5 years?

Will your field work be in this area?

What courses would you want to teach?

What is your philosophy of undergraduate teaching?

How do you feel about involving undergraduates in your research?

What is your philosophy of graduate student training? What will your graduate students work on?

How many students do you expect to have?

How will you support graduate students?

What external funding will you pursue?

What research have you done?

How does your work fit into the big picture? What major questions does it address?

Where will your work be going over the next 20 years?

What do you contribute to the department?

What do you see as your weaknesses?

What do you see as department weaknesses?

What space/equipment will you need?

Why would you want to join this department?

What's the best idea you ever had?

What's the most important question in your field?

Who are three people (or three papers) that have had a big influence on you, and why?

Questions to ask them

1 What is the teaching load for this position? Is scheduling flexible, so I might accommodate intense field seasons? [Don't ask this first, or make it seem like it is really really important for you to get out of teaching.]

2 Are there specific courses the department wants you to teach?

3 What's the usual class size? Is there TA support for larger classes? Is there any TA training?

4 Are there opportunities to develop specialized/smaller classes? Is there funding for course extras like field trips? Give an example of an "extra" you might want to do.

5 What are the requirements for tenure? What's the normal schedule for tenure? [some people say this is a risky question to ask faculty because it makes you seem worried--- asking the dean is okay]

6 Is it possible to stop the clock for family leave? [some people say this is a risky question]

7 Is there office space for graduate students outside of my lab?

8 What are local field sites? Agricultural/common garden sites?

9 Is there intramural funding available?

10 What types of grants do most faculty have?

11 What are sabbatical schedules?

12 What's the departmental philosophy about teaching vs. research, graduate versus undergraduate teaching?

13 How are most graduate students supported? Is this support adequate?

14 what are graduate student teaching loads? Do they have time for their research? How are TA's assigned?

15 Where do graduates and undergraduates come from (geographically, how good are they)?

16 What's the mix of masters vs. doctoral students?

17 Do faculty get along? Is there interaction among different disciplines?

18 Is any new hiring planned in the next 5 years? This is a really good predictor of the health of the department.

19 What seminar series/discussion groups are there?

20 Is there money to bring in outside speakers, for instance if I wanted to develop a focused seminar?

21 Is the library adequate?

22 What are frustrations of graduate students, of faculty?

23 What's the cost of living?

24 Is the chair a rotating position or permanent?

25 When do startup funds expire? Is their use restricted?

26 How are graduate students recruited? If I wanted to accept several in one year, could I?

Dual career couples advice

It is possible! If you are both ecology evolution types you should both apply for all the positions so that the department has both files—this applies even if the job isn't right for the one person.

At the start you have several options:
1) send a joint cover letter and indicate what you want
2) send independent cover letters and say what would be ideal
3) send independent cover letters and indicate the situation
4) send independent cover letters and don't mention anything

The trade-offs are giving them enough time to come up with an additional position versus losing an interview offer because they don't want to deal with it. Jennifer and I did #4. Although giving the university enough time to work on something is good, we found that indicating your intentions at this early stage is meaningless because they have not looked at you or any of the other candidates—all it can do is bias them. Also, it gives them a chance to fairly evaluate each person independently. If you are looking for a shared/split position, in particular, then the cover letter is probably a good time to let them know because getting "two for one" may play in your favor. Generally search committee chairs do not know what to do with this information. The department chair is the right person to talk to—and quite amazingly s/he usually will not tell the search committee.

After you get a call from the search committee, you have two options. Bring up your spousal issue then or later at the interview. Only if you are in a pretty good position (you have other offers, etc., and don't want to waste your own or their time) should you bring it up on the phone (otherwise see below *). Talk to the search chair or call the department chair, depending on how you feel...inevitably, you or the search chair will have to talk to the department chair… and it might as well be you, since the search committee chair will be talking to the department chair anyway. You will get one of several types of responses (surprisingly, nobody will flinch) ranging from "we have a bad history with this and probably cannot do anything for you" to "this is a real possibility, let's work on it." It is imperative that they have your spouse's package at this stage. You do not need to actually be married. Try to be open and honest without making yourself vulnerable. Tell them you are not interested in playing games or playing universities off of each other, just that you want you and your spouse to be happy and productive. If you are flexible about the final situation, don't give them your ultimate bottom line, but rather, when pushed, say that what you are looking for is a situation where both of you can be productive and happy.

At this stage they may want just you to visit or both of you to come out together or separately (separately is generally better because one is not in the shadow of the other). If time is an issue because you have other things lined up, or if they are serious about you or you are serious about them, you should suggest that they invite your spouse out for a seminar in the next couple of weeks—this will serve as a formal interview although they will not call it that. They will pay for it, see your spouse, and have all of the cards when they make the decision.

*If you would rather not bring it up on the phone (or you are not in a particularly strong position) you may want to wait until the real interview… in this case only tell the department chair. This will let you hit them with the news as they are seeing how great you are. Inevitably, on your interview, people will ask you about your personal life. It is not legal to do so, but it happened to me on almost all of my interviews. It is okay to refuse to answer (none of their business)—but this is hard in social circumstances. Do whatever you feel comfortable—it is okay to tell them, and it probably won't hurt you (you will be talking to the department chair any way) – but you will feel violated!

Once you have the offers, you hold all the cards, and you should try to negotiate all that you can… in some cases, the thing you negotiated was the two positions, and thus you won't be able to get more--- on the other hand, if they are investing in two people they probably want (and need) to set you up—so let the negotiating begin.

Random stuff: Some people say it is easier to get two jobs from two jobs than two jobs from one job…. If that is the case, it may be worth going for something not quite ideal with the possibility of moving in a few years.

Some dual career resources:

http://www.physics.wm.edu/dualcareer.html

Lubchenco, J., and B. A. Menge. 1993. Split positions can provide a sane career track - a personal account. BioScience 43:243-248.

Negotiating

Once you get the offer, you hold all of the cards. Talk to lots of experienced people about negotiating—almost Everybody feels like they could have done a better job. Do not agree to stuff you are not prepared to agree to at first. It is always okay to say, you will need to think about that. Or let me get back to you on that. Once you agree to anything it is hard to take it back… There may be several phone calls, several paid re-visits, and several versions of the written offer before you sign. Get things that are important to you in writing. Ask for things you need- don't be embarrassed. If you don't ask you won't get it, and you definitely won't get it later.

Things you can ask for: More time to make your decision, No teaching first year, stay an extra year at your post doc (or have a short post-doc), good start-up funds, good lab and greenhouse space (renovations), moving expenses, support for technician and students, salary, key big pieces of equipment (i.e., ask for a sequencer as a shared core facility that won't come out of your startup), etc.

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EDUCATION

UNIVERSITY OF CALIFORNIA AT DAVIS, Davis, California.
Doctor of Philosophy in Population Biology, May 1999.
Advisor: Dr. Richard Karban.
Organization for Tropical Studies Course *Tropical Biology: An Ecological Approach* (1995).

UNIVERSITY OF PENNSYLVANIA, Philadelphia, Pennsylvania.
Master of Arts in Conservation Biology, May 1994.
Advising committee: Drs. Brenda Casper, W. John Smith, and Neil Shubin.

UNIVERSITY OF PENNSYLVANIA, Philadelphia, Pennsylvania.
Bachelor of Arts in Biology, Magna Cum Laude, May 1994.

FUNDING AWARDS

1997	National Science Foundation, Dissertation Improvement Grant ($10,000).
1996-1997	Organization for Tropical Studies Graduate Research Fellowship ($2,500).
1996	Phi Beta Kappa Graduate Research Grant ($3,000).
1995-1996	Jastro Shields Research Grant from U.C. Davis ($2,800).
1995-1997	Center for Population Biology Research Grant from U.C. Davis ($3,400).
1994	Institute for Environmental Studies (University of Pennsylvania ($2,000).
1993	National Science Foundation – REU at Mountain Lake Biological Station ($2,500).
1989	National Institute of Health and Human Services summer research scholarship ($1,500).

TEACHING EXPERIENCE

Instructor: Ecology and Evolution of Interspecific Mutualisms, University of California at Davis, Fall 1998

Teaching Assistant: Terrestrial Field Ecology, University of California at Davis, Spring 1997, Spring 1998.
Teaching Assistant: Evolutionary Biology, University of California at Davis, Fall 1995, Fall 1996.
Discussion leader: Introductory Biology, University of Pennsylvania, Spring 1994.

Mentored NSF sponsored Young Scholars, Margaret Sherriffs (1996), Chris Koyabashi (1997), Corinne Klein (1998).

PUBLICATIONS

In press

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Agrawal, A. A. Host range evolution: Adaptation of mites and trade-offs in fitness on alternate hosts. **Ecology**.

Agrawal, A. A., S. Y. Strauss, and M. J. Stout. Costs of induced responses and tolerance to herbivory in male and female fitness components of wild radish. **Evolution**.

Agrawal, A. A., J. A. Rudgers, L. W. Botsford, D. Cutler, J. B. Gorin, C. J. Lundquist, B. W. Spitzer, A. L. Swann. Benefits and constraints on plant defense against herbivores: Spines influence the legitimate and illegitimate flower visitors of yellow star thistle, *Centaurea solstitialis* L. (Asteraceae). **Southwestern Naturalist**.

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1998

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1997

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Agrawal, A. A. Do leaf domatia mediate a plant - mite mutualism? An experimental test of the effects on herbivores and predators. **Ecological Entomology** 22: 371-376.

1996

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SUBMITTED PAPERS

Agrawal, A. A., C. Laforsch, and R. Tollrian. Transgenerational induction of defenses in animals and plants.

Agrawal, A. A., P. M. Gorski, and D. W. Tallamy. Polymorphism in plant defense against herbivory: Constitutive and induced resistance is *Cucumis sativus.* **Journal of Chemical Ecology**.

Agrawal, A. A., R. Karban, and R. Colfer. How leaf domatia and induced plant resistance affect herbivores, natural enemies and plant performance. **Oikos**.

Agrawal, A. A. Induced plant defense as adaptive plasticity: Benefits and costs of induction for *Lepidium virginicum* (Brassicaceae). **Ecology**.

Agrawal, A. A. and C. N. Klein. What omnivores eat: Direct effects of induced plant resistance on herbivores and indirect consequences for diet selection by omnivores. **Journal of Animal Ecology**.

Agrawal, A. A. and R. G. Colfer. Consequences of herbivore- and omnivore-infested plants for attraction of predators and parasitoids: A field experiment. **Entomologia Experimentalis et Applicata.**

Karban, R., A. A. Agrawal, J. S. Thaler, and L. S. Adler. Induced plant responses and information content about risk of herbivory. **Trends in Ecology and Evolution** (commissioned).

Agrawal, A. A. and Karban, R. Specificity of genotypic and induced resistance: Gossypol glands influence mites and caterpillars on cotton plants. **Entomologia Experimentalis et Applicata.**

BOOK CHAPTERS AND OTHER PUBLICATIONS

In press Agrawal, A. A. Induced plant defense: Evolution of induction and adaptive phenotypic plasticity. In A. A. Agrawal, S. Tuzun, and L. Bent, editors. **Inducible plant defenses against pathogens and herbivores: Biochemistry, Ecology, and Agriculture**. APS Press.

Gardner, S. N., A. A. Agrawal, J. Gressel, and M. Mangel. Strategies to Delay the Evolution of Resistance in Pests: Dose Rotations and Induced Plant Defenses. Aspects of Applied Biology 53 (Challenges in Applied Population Biology).

1999 Agrawal, A. A. and R. Karban. Why induced defenses may be favored over constitutive strategies in plants. Pages 45-61 in R. Tollrian and C. D. Harvell, editors. **The Ecology and Evolution of Inducible Defenses**. Princeton University Press, Princeton.

1998 Agrawal, A. A. Effects of leaf domatia and induced plant resistance on omnivores in cotton. Pages 127-130 in Hoddle, M. S. (editor). **Innovation in Biological Control Research**: Proceedings of the California Conference on Biological Control. Berkeley, CA.

1996 Agrawal, A. A. Reforestation in Ecuador's dry forest. **Desert Plants** 12: 12-14.
Agrawal, A. A. Evolution will not evolve us. **Global Biodiversity** 6: 21-23.

1995 Agrawal, A. Biodiversity and Sociobiology (review of Naturalist, E. O. Wilson). **Trends in Ecology and Evolution** 10: 218-219.

BOOKS

Agrawal, A. A., S. Tuzun, and E. Bent (editors). Inducible plant defenses against pathogens and herbivores: Biochemistry, Ecology, and Agriculture. Commissioned by APS Press.

INVITED TALKS

1999 Keynote Symposium on Plant-Animal Interactions, XVI International Botanical Congress
Young Investigators Symposium at the annual meeting of the American Society of Naturalists
Vanderbilt University, Department of Biology
University of Chicago, Department of Ecology and Evolution
Duke University, Department of Botany
University of Illinois at Urbana-Champaign, School of Integrative Biology

1998 California Conference on Biological Control (Berkeley, CA)
Symposium on Induced Plant Defense, Joint annual meeting of Phytopathological and Entomological Societies of America
University of California – Santa Cruz, Department of Environmental Studies
North Carolina State University, Department of Zoology
Pennsylvania State University, Department of Biology
University of California – Berkeley, Department of ESPM
University of Toronto, Department of Botany

1996 Symposium on Ant-Plant Interactions at the Ecological Society of America annual meeting.

PROFESSIONAL SERVICE

Manuscripts reviewed since 1996: Oecologia (12), Ecology (3), Ecological Applications (1), Experimental and Applied Acarology (1), EcoScience (1), Oikos (1), Environmental Entomology (1), Evolutionary Ecology (1), Biotropica (1), American Naturalist (2), Bulletin of Entomological Research (4), Journal of Chemical Ecology (1), Chemoecology (1), Blackwell book: Insect Ecology, NSF (2), USDA (1).

1998 Symposium organizer, Frontiers in the study of induced plant defense against pathogens and herbivores, joint meeting of the Phytopathological and Entomological Society of America.
1995-1998 Workshop seminar series coordinator and host (Center for Population Biology, UC Davis)
1996-1998 Post-Doc search committee (Center for Population Biology, UC Davis)
1996-1998 Curriculum committee (Population Biology Graduate Group, UC Davis)
1997-1998 Seminar series coordinator (Department of Entomology, UC Davis)

PROFESSIONAL SOCIETIES AND AWARDS

Ecological Society of America
Society for the Study of Evolution
Phi Beta Kappa (elected)
ARCS Scholar (elected)
Buell Award, Ecological Society of America (honorable mention)
American Society of Naturalists, Young Investigator Award (1999)

UNIVERSITY OF CALIFORNIA, DAVIS

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September 23, 1998

Professor Robert Jeffries
Chair of Plant Ecology Search Committee
Department of Botany, University of Toronto
25 Willcocks Street
Toronto, Ontario M5S 3B2

Dear Dr. Jeffries,

Enclosed please find my application for the Plant Ecologist – Assistant Professor position in the Department of Botany at the University of Toronto. I am very excited about the possibility of joining the faculty at the University of Toronto and contributing to the broad community of organismal biologists there.

I am broadly interested in the ecology and evolution of species interactions in natural and applied contexts. My research program has been funded by the U.S. NSF and produced several senior authored papers in the journals Nature, Science, and Ecology.

Specifically, my research has focussed on three areas: 1) The adaptive value and ecological consequences of phenotypically plastic traits for plants, 2) The influence of plant traits on omnivores in a tri-trophic community of species, and 3) The ecology of mutualistic interactions between plants and predaceous arthropods in tropical and temperate communities. I am currently continuing my work in the community ecology of species interactions, and at the University of Toronto I would like to expand my research program to include an understanding of the quantitative genetics of plant-animal interactions as well as a initiate a modeling approach to understanding the ecology of such interactions.

My approach to science involves three main goals: 1) rigorous field manipulations to test for the importance of conceptually or theoretically developed interactions, 2) the search for novel interactions which may be pervasive in nature but have escaped our attention, and 3) a keen interest in teaching and mentoring students at all levels of education.

Thank you very much for considering my application.

Sincerely,

Anurag Agrawal

Research Interests

I use manipulative field experiments to investigate positive, negative, and indirect species interactions in a range of ecological communities from tropical rainforest to temperate agroecosystems. I have developed a research program which has successfully addressed tri-trophic theory by integrated empirical studies of complex interactions. My research has focussed on the consequences of trophic interactions for plant fitness and arthropod populations.

In my thesis work, I tested the adaptive value of phenotypic plasticity in a common plant-animal interaction: inducible plant defenses against herbivores. My field studies have demonstrated that such plant defense tactics can be adaptive because they reduce herbivory by a community of herbivores and increase plant reproduction compared to uninduced control plants. Following this, a major issue is: if defenses are beneficial, why are they not expressed all of the time? One explanation is that there are phenotypic costs associated with induced defenses in the absence of herbivores. Such costs are typically measured by determining seed production of induced and control plants in the absence of herbivores. A common finding is that such costs are small or difficult to detect. However, I successfully demonstrated that induced plants suffered reduced pollen production (a component of male fitness) and attracted specialist herbivores compared to uninduced plants. These novel costs of plant defense were detected because I studied many components of fitness in realistic settings with multiple herbivores. For the first time, I demonstrated the adaptive value of phenotypically plastic inducible plant defenses. I am currently involved in investigating the specificity of various herbivores in eliciting induced responses in the plant and whether different attackers are mutually affected by induced responses. I will also begin studies on evolutionary aspects of induction using quantitative genetic techniques and specifically asking if inducible resistance can be uncoupled from constitutive resistance. Uncoupling these defense strategies is necessary to understand the evolution of such traits and how they might be used to protect plants.

I have also been investigating plant factors that influence the population size and dynamics of a community of predaceous, omnivorous, and herbivorous arthropods. I have manipulated micro-habitats on plant leaves which enhanced populations of three omnivorous predators. By augmenting plants with simulated leaf domatia (small shelters on leaves), I enhanced populations of predators and these predators were protected from parasitism and intraguild predation. In addition, the system consists of three herbivores, which were each suppressed by the predators. In a factorially designed experiment, manipulating plant resistance and predators, I learned that herbivore populations were more susceptible to predation than plant resistance, and that these two factors acted antagonistically. These studies have anchored me in a solid foundation of understanding species interactions and their relevance to population dynamics in a community context. I intend to expand this part of my research program to include investigations of the relative importance of biotic and abiotic factors that influence the degree to which omnivores are herbivorous versus predaceous.

My goal continues to be the integration studies of plants and their parasites, and also to include studies of potential plant mutualists such as pollinators and predators of herbivores. In tropical communities, I have been studying the benefits that ant predators provide to host plants that house and feed the ants (ant-plants). In this work I documented how herbivores influence ant predators (and vice versa) indirectly through the host plant. Although antagonistic and mutualistic interactions are both thought to be pervasive and important in communities, little is actually known about how they interact. Does parasitism cause hosts to produce reduced rewards for mutualists, or do the hosts actually bolster their association with mutualists to counteract the effects of parasites?

Teaching interests

I hope to teach classes in plant ecology and evolution at University of Toronto. While teaching the basic principles of these fields, I believe that it is important to help students develop an understanding of the scientific method and the different approaches to science (theory, natural history, comparative analyses, and manipulative experiments). This knowledge serves as a base for critical thinking. By the end of a course, the undergraduate student should have a general sense of the field, what important contributions the field has made to science, and how progress in that field is made. In giving lectures, my belief is that organization and enthusiasm are keys to successful teaching. Dynamic lecturing not only captures the attention, but hopefully the imagination, of the students.

I have had very productive research collaborations with undergraduates. My approach is to introduce interested undergraduates to experimental methods and literature, spend a lot of time with them at first, and to give them more independence as time goes on. In addition, I find that progressively increasing the level to which I challenge them helps develop independent thinking. These types of collaborations with students have resulted in three co-authored publications. In addition, I regularly offer to read classic papers with undergraduates as a weekly exercise. Two questions that inevitably arise each week are: "What is the contribution of this study?" and "What would you do next?"

In general, I believe that organismal biologists must be firmly in tune with what is happening in nature. For that reason, I am particularly enthusiastic about laboratories and field courses. In particular, I would like to develop or participate in teaching a field course at the University of Toronto that involved a "mini-thesis" for advanced undergraduates and beginning graduate students. The course would be initiated by an intensive field experience in the fall in which students determine testable hypotheses. By the end, students would be familiar with many aspects of the "hypothesis testing" research program: reading literature and being aware of conceptually rich issues, observing, asking questions, using well controlled manipulative experiments to test those questions, and presenting results in both oral and written form.

For graduate students, picking specific questions and having a grasp of the bigger picture are important skills to learn. Reading groups and seminar discussions are a key part of this process. I would like to offer seminar courses on current topics in community ecology, interspecific mutualisms, grant writing, and other areas of mutual interest chosen by the students. On a more personal level, mentoring students must involve several aspects. First, doing projects WITH students, as opposed to giving students projects is essential. I learned many of the research skills (from designing the experiments to writing them up) by actually doing them with a mentor. Secondly, I believe it is important to learn from students in addition to teaching them. This not only enriches the experience for the teacher, but also for the student. Challenging students while being encouraging is perhaps the most important aspect of teaching for me.

Sample Startup Budget		Cost
Lab	refridgerator	1,800
	microbalance	12,000
	top loading balance	750
	freezer	1,300
	tissue grinder	500
	micropipetters, 4	1,200
	environmental chambers, 2	16,000
	lab glassware	5,000
	chemicals	3,000
	rearing cages	2,000
	Spectrophotometer	15,000
	centrifuge	5,000
	-80 freezer	5,000
	rotary evaporator	5,000
Office	3 desktop computers	7,500
	2 Laser printers	3,000
	1 laptop	5,000
	slide projector	500
	software (stats, graphics)	5,000
	books/journals	2,000
Field Equipment	large field cages, 16	6,000
	small field cages	2,000
	field balance	500
	tools (shovels, hoes)	500
	nets	500
	pickup	20,000
Greenhouse Equipment	pots	500
	soil	500
	lights	1,000
Technical support	undergraduate field assistants	5,000
	Lab Tech (2 years)	50,000
	total	≅200,000