

**IJEE SOAPBOX:
ECOLOGY AND EVOLUTION AS PROFESSIONS,
AND AS LIBERAL ARTS**



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All biologists know that the phenotype is a reflection of the interaction between a genotype—what an organism “is”, as governed by its DNA—and an environment—all those contingent details of what an organism experiences as it lives its life, modulated by epigenetic processes such as genetic imprinting and maternal effects that straddle generations. In like manner, the lives and careers we craft are governed both by who we are (our drive, interests, motivation, and talents) and by where we live (within those broad currents of the educational, intellectual, sociological, and educational milieu in which our life-trajectories are crafted, or sometimes driven). The world constrains our dreams.

The thoughtful paper by Marshall et al. (2009; this issue) brings out the very challenging standards—as assessed by publications and other metrics of professional experience and accomplishment—that must be met these days to land a position in ecology or evolution in higher education. In this essay, I use the Marshall et al. paper as a springboard to reflect on some general issues in entering ecology as a profession, which I hope readers find of use. The pursuit of ecology and evolution can be wonderful professions. Also, I firmly believe that an understanding of ecology and evolution enhances whatever profession one chooses to follow, is essential to effective citizenship, and in general enriches one’s life as a sentient being in this splendid, troubled world we inhabit.

So let us step back for a moment from the issue of what individuals need to do to be successful in the academic marketplace, to reflect on how an appreciation of ecology and evolution fit into the broader issue of becoming an educated person. One mark of being human is our capacity for education. What is “education”? Howard Lee Nostrand (1946, cited in Rosovsky 1990, p. 100) stated that “education means the whole development of the individual, apart from his occupational training. It includes the civilizing of his life

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purposes, the refining of his emotional reactions, and the maturing of his understanding about the nature of things according to the best knowledge of our times.” Leaving aside the dated gender-specificity of this quote, the general thrust of this definition is in the right direction but warrants refinement.

To me, education is like a seat that rests on three legs, where each leg reflects one of three principal goals we should have for education, both as individuals and as a society.

One of those legs is the development of the knowledge, skills, and mental acuity needed to craft a profession, a career, so as to have meaningful and gainful employment providing the wherewithal to support oneself and one’s family. It is hard work to become proficient at any activity, and a primary aim of education at any level—kindergarten through post-graduate—clearly should be to give individuals the conceptual tools and mental agility they need to make their way in the world. This is becoming an increasingly challenging task, given the exponential growth of knowledge and the overall rapidity of change. So learning how to become educated, and re-educated, in a continual cycle of reinvention of the self, is itself an important dimension of education.

Another leg of the seat is the need to have citizens with enough knowledge and wisdom about the world that they can act as reflective, thoughtful participants in the democratic process. An appreciation of the diversity and complexity of the human and natural worlds is, in my view, essential for citizens to participate intelligently in a democracy and thus help guide how political decisions are made.

The third leg—and one aspect of education that is increasingly neglected, in our world of standardized tests and outcome-based metrics—is that all human beings are valuable for themselves qua themselves, and so deserve the opportunity to enjoy rich, meaningful, self-actualized, and engaged lives. Education should help individuals develop the intellectual tools and perspectives needed to reach their full potentials. I suppose this is an old-fashioned perspective, but there it is.

An education in ecology and evolution can be valuable for each of these legs. In the next several paragraphs I ruminate on each, in turn.

One reason to study ecology and evolution is because these are the careers one chooses to pursue. Often students pursue doctorateS so as to become professorS themselves. Given this aim, it is important (as Marshall et al., 2009, emphasize) that students grasp at the outset the hurdles that must be surmounted to achieve this goal. There are broad structural constraints on the profession that are inescapable and make becoming a professor rather difficult. There is no doubt that at present higher education in the US (and likely elsewhere) faces serious challenges, due for instance to a chronic long-term decline in support of public universities by public monies, and to an increase in a kind of corporate mentality in university governance, all compounded by the current economic crisis. It is somewhat difficult to characterize fully the nature of the academic marketplace, but it is worth taking a stab at quantifying it. Marshall et al. (2009) note that in 2007, around 7,000 Ph.D.s were awarded by American institutions in biology, but only on the order of 100 academic positions of any sort were advertised in the *Chronicle of Higher Education* (a common American repository for academic ads) in the month of

December, 2008. If we imagine a comparable number were placed each month, and each ad was posted for a month, then there would be roughly 1,200 ads in that year (this likely overestimates the number of academic jobs annually available in biology in higher education). For instance, in 2006, there were 9,683 Ph.D.s awarded. Of these, around 25% reported having definite employment at the time their degree was awarded (<http://chronicle.com/article/Characteristics-of-Recipients/47071/>). If we assume that a similar fraction held throughout 2007 and 2008, and that all the positions advertised in 2007 were filled, with no overlap between the 25% reporting employment, and these positions being advertised (and presumably getting filled), then about 2,000 and 3,000 positions (both professorial, and not) would be filled during 2008. Clearly, considerably more students achieve doctorates in biology than are likely to find positions as professors.

The picture these young investigators paint is a sobering one, but it is not a problem unique to our discipline, nor even to our period in time. It is the nature of the beast. Disciplines like history and literary studies have chronically had shortages of academic positions, relative to the number of bright folk seeking doctorates in those areas. I clearly recall physics graduate students and postdocs at Princeton in the early 1970s (the department there was at that time ranked the best in the world) wandering the halls of Fine Hall late at night, bemoaning the shortage of positions.

It is difficult when one is living the life, particularly when one is young and deciding which direction to pursue, but we have to distinguish between the interests of individuals themselves, and those of society as a whole. Being a professor is by many measures (not necessarily financial) an enviable life, and ecology and evolution are fascinating, engaging subjects that appeal to many people. So it is no surprise (at least to me) that many talented, creative people are attracted to this career track. What makes this situation difficult and at times very painful, from a human perspective, is that there are many more good people attracted to this discipline than can be accommodated in canonical professorial positions, at least given the way our society is currently structured. As the saying goes, “Many are called, but few are chosen” (Matthew 22:16).

There is a kind of necessary pyramidal structure to the educational world, which one could portray as a sort of an Eltonian pyramid. Many more students as undergraduates are interested, for instance, in marine biology, than are admitted to graduate programs, and then many fewer faculty positions are available in this area than the number of graduate students and postdocs produced. Graduate education usually requires a community of students, permitting courses to be developed and taught. It also requires practice to become an effective teacher and mentor, which means that if a faculty member has graduate students—and certainly more than one will usually be needed, at any given time—there will always be more students than faculty, at any level. If a large fraction of these students aspire to become faculty themselves, it is essentially impossible for all of them to achieve their ambitions. This seems cruel at the level of the individual, but it makes sense at the level of society, since there is a competitive winnowing which (ideally) identifies the very best individuals to push back the frontiers of knowledge and act as educators. Most professors depend in a sense upon the largesse of some other group of people—the public, or donors, or tuition-paying parents and students—for their

livelihoods. The public good is thus best served when a competitive process (one hopes, merit-based) allows a large pool of talented people to compete for these limited slots. (Similar processes operate across a range of socioeconomic systems.)

Abstractly, the professoriate in any given discipline is a kind of population, and as population biologists, we know what this entails. With rare exceptions, the size of this population does not change much over time. One exception was in the late 1950s and early 1960s, when the size of US institutions greatly expanded; another is in China at present, where a number of new universities have been recently created. Leaving such transient episodes aside, though, when a population is in equilibrium, its birth rate must match its death rate.

So, we expect professorial “births” to approximately match their “deaths”. A “birth” is scored as that time when a professor is hired; comparably, a “death” is when that professor either retires, or (Lord forbid) actually dies, prior to retirement. If most Ph.D. faculty retain a position for, say, 30 years, the average professor should expect to place one “offspring” into a comparable position over his or her academic lifetime, which would be an annual reproductive rate of 1/30. The longer we all live and are productive (and in American academia there is no longer a mandatory retirement age), the lower the latter number should become. Some faculty may (and do) produce many more students who become professors than this, but in this case, other faculty will be producing none at all.

These public good and demographic perspectives clearly imply painful consequences for many individuals, who find that it is difficult or impossible to live the life they have dreamed and worked so hard to pursue.

But it is important to keep several things in mind.

All historical processes—and faculty searches are no exception—reflect the interplay of determinism and stochasticity in reaching any given outcome. The “winnowing” process noted above has many random elements at each stage. By “random” here I do not mean that a coin is metaphorically tossed, but that the unpredictable idiosyncrasies of the details of candidate profiles relative to the self-perceived needs of a department come into play. This is particularly the case at the final stage of faculty recruitment, when often one is dealing with small numbers of individuals. Having served on many faculty searches, I am convinced that in most cases there is a substantial chance element in who gets interviewed, and then who gets chosen in the end. Not getting selected for an interview, or not getting an offer, is often no reflection on the intrinsic merit of one’s qualification or research profile, but a matter of “fit” with a department. This is weak solace when getting a rejection letter, but should be kept in mind.

Moreover, many of the quantitative criteria mentioned by Marshall et al. (2009, this issue) (numbers of publications, grants, etc.), are used largely in faculty searches as indicators of other attributes, such as creativity, intellectual coherence, methodological care, and the like, which are at the heart of long-term success in the academy. There is a substantial spread in these metrics among successful candidates, and some applicants are certainly successful even without papers in top-rated journals such as *Science* and *Nature*.

Here is some advice, for any students who happen to read this essay. I am somewhat old-fashioned, so I try to actually read at least a decent sample of the papers and other materials provided in applications, and pay close attention to letters of recommendation, as well as the craftsmanship of candidates as evinced in cover letters, research statements, and the like. Being first author on a paper to me means that individual did the bulk of the writing. There is a determined push in ecology towards larger and larger collaborative projects. This makes it increasingly difficult for any participant on those projects to actually produce first-authored papers, I suspect. I particularly pay attention when a candidate has at least one singly-authored paper, since that then is truly his or her “voice”. So one piece of advice we can give to all our students is to stick their necks out and write a paper that is just purely them. Of course, if all students do this, this simply ups the ante, without altering the basic structural issue that Marshall et al. address.

In my opinion, a doctorate in ecology and evolution has great value, beyond just being a way-station in the very competitive academic market in these disciplines. For instance, a number of students and postdocs in my acquaintance have gone on to have interesting and fulfilling careers in arenas outside the academy, such as in the government, or NGOs, or environmental consulting firms, or publishing, and they are at least as fulfilled in their careers (and often, more so) as those who have become professors. When I think of some of my own students and postdocs, one is happy as a clam in an environmental consulting firm, others have excellent positions in the National Park Service or the United States Geological Survey, or in state agencies, and of course some have outstanding academic positions. Some students have gotten a law degree and are now specialized in environmental law. All of these career paths, in my view, are as meritorious as being a faculty member at a college or university. As my grandmother Mattie Holt once said to me in a conversation about the field laborers on the family farm in Tennessee, “there is dignity in all honest work.” I firmly believe that. Moreover, even within the professoriate, there are many more opportunities to fashion careers at largely teaching institutions than at major research institutions, so opportunities to become an effective teacher should be integral to a graduate education. Graduate education should thus be structured so as to permit students to pursue a wide range of career trajectories. And professors need to respect the full panoply of alternative career routes that their students may need and want to explore.

To be successful in this wider world, it is essential that one think beyond the straightforward requirements of what is needed as a larval professor hoping to eclose into a lectureship or assistant professorship. The mantra of academia is “publish or perish”. This is completely true, but it cannot be emphasized enough that the exercise of crafting manuscripts and getting them published, and giving talks at meetings on the work, has enormous value beyond just providing the necessary coinage of the realm so as to land a job. It is a vital part of graduate and postdoctoral education that resonates in essentially any career trajectory. Learning how to write and communicate effectively, both on paper and in oral presentations, is possibly the most important tool in the skill set that graduate students should take away from their education, regardless of their career path.

And speaking of skill sets—students and postdocs in their training need to be aware

that, in addition to tackling intellectually significant issues that excite them personally, it is essential to develop a suite of concrete and identifiable skills, which will allow them to pursue a wide range of career paths, outside the usual academic route of assistant up to full professor. These skills could be molecular genetic tools, or GIS, or statistics and computational expertise, or even the graphics arts. Many of my own students are interested in spatial ecology, and so I urge them to take a suite of courses which give them a professional GIS certification. Were I starting my career over now, I would make a serious attempt to increase my fluency in Spanish and French, or even attempt to learn a non-Western language such as Mandarin or Arabic. English is (for now) the language of science, but if one can speak other languages, it expands the world you can live and move in. Emigration has been the historical human response to over-crowding, and that holds in academia as well as anywhere else. Increasing cultural and linguistic fluency can expand the geographical domain within which one can contemplate landing positions, and is of course also valuable for many reasons beyond simply landing a position.

The above remarks have to do with the “careerist” leg of the chair of education. What about the other two legs? I will just say a few words about each; they warrant much more attention than I give them here.

An understanding of ecology and evolution is, I think, critical to being an effective citizen of our complex, interconnected, and environmentally vulnerable world. In part, this is because ecological issues are themselves ever more important as issues which require concern and effective political action. But even if this were not true, I am convinced that the intellectual perspective one gains by the study of ecology and evolution can help inform an appreciation of all facets of human society. After all, the structure and dynamics of society are determined by processes at local, regional, and global scales, and causal forces flow in both directions between individuals and social structures at many scales—just as in ecosystems. An appreciation for contingencies, and for the likelihood of surprises emerging in complex systems with multiple causal feedbacks, and for issues such as persistence, resilience, and rapid transformation—all of these are at the heart of our science, and all are also enduring features of the complex social world we inhabit (e.g., see the essays in Lewontin and Levins, 2007). I am convinced that for these reasons ecology should be part of the educational experience of all students, and not just those who intend to become professional ecologists of whatever stripe, because it gives citizens essential conceptual tools for thinking past the pallid nostrums that all too commonly substitute for critical thinking in our current political discourse.

Finally, I strongly feel that some appreciation for ecology and evolution substantially enriches the lives of individuals, in effect by expanding the cognitive and perceptual worlds that each human being inhabits, reacts to, and influences. E.O. Wilson has argued that human beings have within them a nearly universal desire to connect with other living things, which he calls “biophilia”. I am not certain that we have a hard-wired “innate” tendency of this sort, but that may not really matter, for as Wilson goes on to state, “Humanity is exalted not because we are so far above other living creatures, but because knowing them well elevates the very concept of life” (Wilson, 1984, p. 22). In other words, we enhance the quality of our own lives by coming to appreciate natural

history in its deepest sense—not just by knowing the names of some of the creatures we share the planet with, but by knowing as well something about their lives, and about the driving forces and constraints which—over vast spans of time and space—have shaped the world around them, themselves, and ourselves. As Darwin so beautifully said in the closing sentence of *On the Origin of Species*, there is “grandeur in this view of life” (Darwin, 1859). Ecology and evolution should be viewed as essential components of the liberal arts, because an exposure to these disciplines helps one to sense and creatively respond to the grandeur of the world around us. And so, the liberal arts should be viewed as essential to education, and ecology and evolution should be integral to the liberal arts. For all these reasons, one fruit of our educational systems should be that there is a little bit of an ecologist and evolutionist in all of us.

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