The Habits of Successful Ecologists: learning from the best

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We begin this series in earnest by examining those at the very top. The scientific elite who either by wit or judgement have made their way upwards and now form a new breed – the highly cited scientist. Most scientific publications are authored by a small proportion of researchers, and the majority of citations reference a relatively small pool of articles. Highly cited scientists comprise the top 0.1% of the most cited researchers in their field, according to Thompson Scientific. They have a disproportionate impact on their field and science in general. How did they attain this hallowed status? What can we learn from them? And are they characterised by certain traits that could be emulated?

Some characteristics are harder to change than others. Most highly cited ecologists are middle-aged, white, male and work in North America or Western Europe. However, most academic scientists are male, middle-aged and are based in (or move to) these areas. Highly-cited ecologists are recruited from this, the largest pool of researchers, and a sex-change is unlikely to automatically improve your performance. The difference in gender success in science is likely because women still generally spend more time on family obligations than men, and many research institutions do not accommodate this imbalance. Despite this characterization, it is important to realize that it takes substantial time for citations to accrue, thus these findings reflect the demography of individuals most of whom began their careers more than twenty years ago. The interim has seen significantly increased representation of women and non-Western researchers within the scientific community, while scientific careers are starting later. Highly cited scientists of the future will likely be more diverse in terms of gender, age, and geography.

Bill Laurance, a typical 'highly cited' ecologist.

But, do highly-cited scientists have work habits or personality traits that engender success? Most successful ecologists drink more than average. They work a long week, but less than the average PhD student – good news for some of us! They spend most of their time writing papers, mentoring students and postdocs and running experiments and analyses, and service-related activities such as reviewing papers or grants. Teaching is a lower priority.

In terms of the resources available to them, highly-cited ecologists tend to have large labs, with a number of undergraduates, postgraduates, post-docs and technicians working with them. They also generally have higher than average levels of funding. However, this trend belies the many ways that ecologists are successful. Many highly-cited ecologists have little or no lab or funding. Good science does not wholly depend on physical resources and there are many ways to the top.

What kind of science to highly-cited ecologists engage in? They tend to address theoretical questions, rather than more applied aspects. Given that theoretical concerns are likely of wider interest, it makes sense that they are cited more often. However, virtually all highly-cited ecologists have a wide range of research interests, investigating a variety of subjects. Furthermore, they are adept at navigating the peer-review system, receive few rejections and publish most of their work in their first-choice journal.

Table 1a. The frequency of reasons for citation among highly-cited ecologists and environmental scientists

Reasons for Citation	Percentage
Significance	32%
Novelty	31%
Utility	23%
Synthesis, broad questions, interdisciplinary	21%
Interest	21%
Clarity and readability	15%
Elegance and reliability of methods and data	11%

Asked why their work is highly cited, citation elites in ecology and the environmental sciences tend to place most emphasis on the significance (the importance of the author's contribution or the problem it addresses) and novelty (how ground-breaking the contribution is) of their research (Table 1a). They also emphasize the usefulness of the contribution

to others in the scientific community, research that addresses broad, synthetic topics, and which is currently of substantial interests (i.e. 'hot topics'). Clarity of presentation and elegance and reliability of methods and data are also noted as important determinants of citedness. Asked about the characteristics of highly cited researchers, this group tends to most emphasize their productivity, creativity, willingness to address broad/synthetic questions, their motivation and persistence (Table 1b). Communication skills are noted as important characteristics of these researchers, as is working in a quality environment which facilitates and supports their research and being inherently curious about and engrossed with one's work.

Highly-cited researchers currently work in the wealthiest parts of the world. Whether they were lucky enough to be born in here, or migrated from less wealthy places, access to a certain level of resource availability appears essential for success. Given these resources, there are a variety of ways to succeed in science, attain highly-cited status and potential scientific immortality. Given the wider access to science and scientific careers, as well as recent investment in science by non-western countries, it seems likely that the diversity of highly-cited ecologists is likely only to increase over the coming years.

Table 1b. The frequency of characteristics of highly-cited researchers.

Characteristics of Highly Cited Researchers	Percentage
Productive	33%
Creative/Innovative	31%
Willing to address broad/synthetic questions	28%
Motivated/Persistent	25%
Good communicators	19%
Work in quality environment	15%
Curious/Engrossed/Enthusiastic	13%

Data from Parker et al. *unpublished data*. These were further questions to those presented in Parker et al. (2010). Respondents were free to offer more than one answer to each question, thus the columns do not sum to 100%.

Finally, while all of the things we suggest may help someone get highly cited, they can also be dangerous when the goal of scientific writing becomes garnering citations rather than making meaningful contributions to your discipline. We would further suggest that important scientific breakthroughs (and the citations which accompany them secondarily) are often the result of people working passionately on topics that they care deeply about. Citations are not ends in and of themselves, and should not be sought as such. The goal of science is to improve knowledge for the collective enterprise, not to become highly cited individuals. That type of goal displacement happens all to often and has the potential to erode the intrinsic satisfactions of scientific work. Do good work, try to enjoy the process, and if you get cited, all the better.

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Dr Phyllis Coley, Distinguished Professor of Biology, University of Utah.

PROLIFIC PROFILE #2: Phyllis Coley

Lissy Coley is a Distinguished Professor of Biology at the University of Utah, USA. Most of her work has focused on the role of defences in protecting plants from damage by herbivores and pathogens. Her early research quantified patterns of plant defences and tried to understand how selection may have favoured different defence investments in species of different life histories and habitats (e.g. 'resource availability theory'). She chose to address these questions in tropical rain forests because the high diversity allows multi-species comparisons, and because biotic interactions have played a particularly strong role in shaping tropical communities. She has authored a total of 86 publications and is, of course, highly cited (Figure 2).

BES: How soon in your career did you author your first publication?
PC: I was a third year grad student. It was a single authored paper in Nature, but I was so naïve I didn't know that was a good journal, just that it took short papers.

BES: How important do you think it is for young academics to publish early and often?
PC: I think it is very important to have publications early on. This gives you the experience of taking something through to completion, hopefully building confidence and taking away some of the mystique and fear surrounding publishing. In addition, when you look for a job, it shows you are capable. Often thesis research is written up in the last year of graduate work and therefore is not accepted when you are looking for postdocs or jobs. So picking a smaller project that you can complete early on is a good idea.

BES: How do you maintain a good publication record while pursuing major research projects that may take years to complete?
PC: Initially this is hard, as there is not too much in the pipeline. However, 2 good papers a year after a PhD is generally considered productive. It gets easier with time, as projects with different completion times come on line. To make sure something is coming out frequently, it is helpful to think of one's research in terms of publishable chunks, and to try and complete them as efficiently as possible. However, I do NOT recommend increasing publications by splitting up a story. It is the more complete papers that present a memorable and substantial contribution to science and in the end may also provide greater visibility to you.

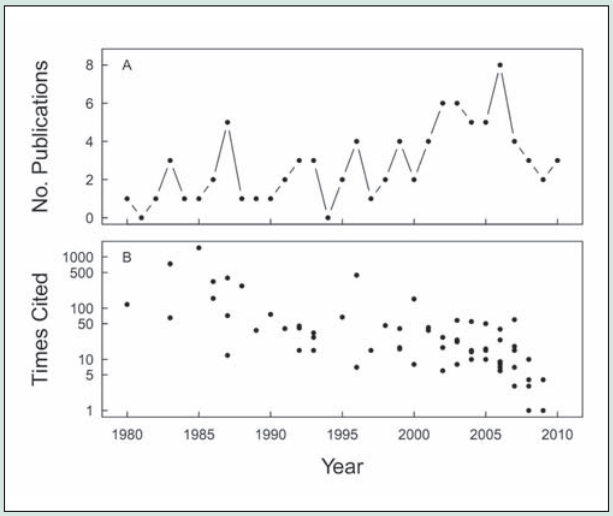

Figure 2. *Number of all publications (A) and times cited of journal articles (B) by year for Lissy Coley. Data from Web of Science (accessed 18 March 2011) and Lissy's web page.*

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BES: How important are collaborations in maximising research efficiency, and does this change as one gets further along in one's career?
PC: Collaborations build naturally over one's career, and can range from fulfilling to stressful. For young scientists, collaborations are fine, but it is also important to publish research that is clearly yours.

BES: What motivates you in your work?
PC: I like puzzle solving and the wonders of nature, but that did not translate initially into knowing I wanted to be a scientist. In graduate school I liked doing science, but lacked confidence that I could do it. I also wanted time to play outside and regularly thought of dropping out. However, over the years research has became more and more fun, and I can't imagine a better job. Recently, like many people my age, I am trying to make my expertise relevant to real world problems such as loss of biodiversity.

BES: Any other thoughts?
PC: I think it is important to remember that there is no simple formula for success or for publishing. Above all, one should listen to one's data and one's own personality so that you don't lose track of the reasons you enjoy science. This (plus hard work) will give not only the greatest pleasure, but also the greatest success.

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