F1000 review of "Heavy use of equations impedes communication among biologists."

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I fully concur with the patterns described in the evaluated paper, and also with the evaluations. I have a different opinion about the processes that are involved in the described pattern, i.e. biologists do not like papers with lots of equations and, hence, do not cite them. I am one of those biologists. The first thing I do when I encounter one of these papers is to read the introduction, of course, to see what it promises, and then I read the discussion to see what is maintained. I then try to understand what variables were considered, and what were the interactions among them. Usually I stop there. The verbal model of the general mathematical model is usually very naive in that it makes assumptions and generalisations. It might emerge that planktotrophic larvae are favored when there is plenty of food in the plankton, and lecithotrophic larvae are favored when plankton is scarce. One should be able to arrive at this conclusion without a mathematical model. If I know the system that is going to be described with equations, I have an idea about the relevant variables and about their interactions. I have seldom encountered an equation-filled paper that has satisfied my expectations in terms of considered variables and relations. Mathematical models may not present a true representation of what it is they are trying to study. Perhaps the mathematics used in this paper is first class, but this may not translate into the fact that the biology and ecology of the article are accurate. Biodiversity is just a handful of species; predation and competition are not accurate at all (even if sometimes they are measured with the greatest precision). Parasitism is usually absent; species are just adults, and there are no life cycles and life histories. The mathematics is beautiful, but the natural history is not.

Now, what is the purpose of these articles? Is it to make an exercise in mathematics, or is it an attempt to show how the natural systems work? I can find a beautiful correlation between nutrient availability and primary production, but does phytoplankton come out from nutrients? The presence of benthic resting stages developing then in planktonic organisms is rarely, if ever, introduced in equations describing plankton production. Phytoplankton comes out from nutrients! I do not have much interest in reading a paper that is based on these premises. Theoretical biology is not just the description of natural phenomena through equations, as rightly suggested while citing Darwin as a theoretical biologist who did not use equations. In the Origin of Species, Darwin wrote: “I have taken some pains to estimate the probable minimum rate of elephant’s natural increase...” The way he describes the exercise (it cost him pain) shows that he did not like at all to use his brain for searching evidence in numbers written on paper. He thus liquidates the issue with: “...but we have better evidence on this subject than mere theoretical calculations, namely, the numerous recorded cases of the astonishingly rapid increase of various animals in a state of nature, when circumstances have been favourable to them for two or three following seasons”.

Biology is a historical science; it is not like physics. It is governed by contingencies: they are the drivers of history. And they cannot be included into mathematical models with much reliability: the future of non-linear, complex systems cannot be predicted with equations. Economists tried, and we see the result; very nice economic equations that lead to disaster in the real world. Using the tools of a-historical disciplines (governed by constraints) to handle historical disciplines (governed both by constraints and contingencies) is an epistemological mistake. So, we will have more care for these articles when we will see, in them, more care for the variables and their interactions. Natural history is just that: history. Historians do not handle history with equations. Economists do. Among the variables that they avoid considering there are the natural costs of economic enterprises. Or, if they are expressed, they are very naive. So, yes, biologists do not like formula-filled papers dealing with biology. But maybe those who write these papers do not like biology so much. They want to adapt biology to their mathematics, but it should be the other way around.