The Moon in the Nautilus Shell: Discordant Harmonies Reconsidered

by Daniel Botkin

reviewed by Charles Gasparovic

As President Obama launches his new initiatives on curbing carbon emissions, Daniel Botkin's new book, *The Moon in the Nautilus Shell*, comes as a timely gift to climate change deniers in search of new talking points. Though mostly a critique of wildlife management—a history of errors in the ways of ecologists and the policies they influence—the final few chapters of the book take on climate science, in a portrayal of that field that is likely to resonate in the public forum much more than the rest of the book.

Botkin has a long and distinguished career in ecology and is the author of several popular books. But he places himself in a minority of ecologists—a self-defined maverick—and he is not a climatologist. So, almost by definition, there will not be wide agreement within those fields on some of his points. However, his comments on the general need to maintain open and objective thinking in science, in spite of our inclination to close ranks around emotionally charged themes, will, it is to be hoped, strike a chord in all scientists, as well as among politicians and policymakers and in the wider public.

Emotions and irrationality are intertwined with the rational in our brains—that's just the way we're wired—and the practice of science is not always a safe haven from that. We all claim to value objective truth, but what most of us really want most of the time is to be right on a personal level. Botkin presents several cases in which objectivity did not prevail in ecology and wildlife management, with unintended consequences. Better to recognize our human failings, he admonishes, and work around them as best we can, at least when trying to be objective and rational for the greater good.

Unfortunately, it is not always clear that objectivity trumped the desire to be right in his own book. Many of Botkin's comments on the present state of ecology could easily be mistaken for axe-grinding, whether justified or not, over the fact that his 1990 book, *Discordant Harmonies*, did not transform the field the way he intended; and, to many, his take on climate science, conflating its supposed shortcomings with those of ecology, might come across as simply a bait-and-switch.

In the first eleven chapters of the book, Botkin makes the case that ecology has been and still is dominated by believers in ancient Earth myths or modern machine metaphors, viewing nature as being in a state of constant balance, ideal for the flourishing of all present life forms, until, of course, humans muck things up. Furthermore, he contends most ecologists are not very good at mathematics, computer models, or gathering useful data that might
challenge this view. This has led to the application of overly simplistic models of population growth in wildlife management—of everything from fish in Alaska to elephants in Africa—with little basis in the reality of the much more complex and ever-changing natural environment.

Botkin’s fellow ecologists will no doubt debate whether his examples of bad mathematics and botched management are really representative of their field, or whether they have moved on in the last few decades (Brown 2013, Nekola 2013). However, equally or even more controversial will be the last few chapters of the book, when Botkin steps outside of ecology and puts climate science on pretty much the same stand—myths and bad math—but this time with little supportive evidence.

The evidence Botkin does provide are indeed concerns for climate scientists, but not ones that have been ignored due to a lack of appreciation for the daunting complexity of the climate. He does seem to acknowledge this from time to time by stating that climate science is divided over the anthropogenic contribution to climate change. But this is a bit misleading, too. It glosses over the fact that there are areas of large consensus in the field, particularly with respect to the human contribution to climate change, with 97% of well-published experts in the field agreeing that it is significant, according to a recent paper in the *Proceedings of the National Academy of Sciences* (Anderegg and others 2010).

Of course, consensus does not always translate into correctness, another theme in the book that most would agree with. But to make his case, Botkin directs the reader to shortcomings of climate models and examples of unexplained data, rather than a broader survey of the field. While the issues he raises are certainly important ones that climate scientists are striving to solve, by focusing on the challenges of climate modeling and on unexplained rather than supportive data, he is likely to leave non-scientist readers with the impression that the whole field of climate science is a house of cards, just like the picture of ecology and wildlife management Botkin paints. Unfortunately, such readers will not come away with any idea of how the great majority of the experts in the field, who are in fact good at mathematics and gather lots of data, deal with these issues themselves.

A good example of this is the 800-year lag of CO₂ increases behind temperature rises estimated in glacial ice core samples. These estimates are based on the carbon isotopes in CO₂ and the oxygen or hydrogen isotopes in water that were trapped in the ice at different stages of its formation. Botkin presents this as simple evidence against CO₂ causing warming, giving short shrift to the large literature on whether this gap is an actual lag or has more to do with different rates at which the CO₂ and water are trapped in the ice, global heat fluxes, or other factors. In fact, new estimates of the lag have reduced it to statistical null, with a trend for CO₂ to lead warming after the initiation of interglacial periods. An important paper by Shakun and his co-workers (2013) reporting this came out after Botkin’s book, but the concerns about the measurements have been discussed for years.

Similarly, Botkin shows a figure from a paper by the climate change skeptic Willie Soon (2005), showing a high correlation between temperatures in the Arctic and solar irradiance over the last 130 years and a weaker correlation between the same temperatures and global CO₂. At first blush, this figure certainly seems like an irrefutable show stopper. CO₂ is obvi-
ously completely outclassed by solar irradiance as a global warmer. How could the rest of the scientific community ignore this?

In fact, they didn't. Temperature changes vary greatly across the planet and Soon himself is careful to make his conclusions about Arctic temperatures, not global temperatures. The question of how much solar irradiance or other factors contribute to global temperature changes is obviously important. But the point Botkin seems to be trying to make by showing just these data is that atmospheric CO₂ is not as important as solar irradiance for global warming, while ignoring reports on the same or similar data, which appeared before and after the Soon paper, that would dispute this simple interpretation (for example, Barnhart and Eichinger 2011).

Among Botkin's more general concerns are the steady state assumptions in climate models: that certain atmospheric or energy parameters don't change, or should be at some past level, when everyone knows that the climate has been a moving target since there was one on the planet.

Like Botkin, I am not a climate scientist, so I cannot offer an expert opinion on climate models. But from my experience in other fields of science, I know that complex and otherwise intractable problems in science are always dealt with by approximate models, and sometimes by assuming pseudo-steady state conditions. This has been the case, for example, in modeling kinetics in biochemistry. This is a field of science that is also beset with highly complex problems, but one that has given us, nonetheless, our present understanding of the physical basis of life and, that, in spite of the gaps in that understanding, underlies most of modern medicine. Rather than always just a bad idea, the decision to assume a pseudo-steady state is generally based on the different magnitudes of the rates of processes captured in the model—is one thing changing a lot faster than another thing?—and, ultimately, on how forgiving the assumption is in the overall fit of the model to the data. Is it usefully predictive and, if so, over what time or space interval?

These are undoubtedly difficult questions to address when modeling highly complex phenomena such as long term climate trends, and perhaps this was Botkin's only intended point. It would certainly be misleading to suggest to the public that a computer model is not useful for predicting trends just because it makes simplifying assumptions, including steady state ones, to solve highly complex mathematical problems. Virtually all of science is based on conceptual models that are our best approximations of the phenomena we try to understand, given the available data and the limits of the human intellect. It would also be misleading to suggest that such models need to fit the data perfectly to be credible within some acceptable range of confidence. Finally, it would be misleading to suggest that most climatologists simply don't understand their models, as was claimed to be the general case in ecology.

Misrepresenting climate science was obviously not Botkin's intent in this book. Reading it, one would never doubt his concern about the sustainability of our species and our impact on the environment, or his desire for a truly open debate on wildlife management and climate change. However, this debate will be better served with a more balanced description of climate science. Anything less will only perpetuate the polarization of uninformed people and policymakers that Botkin laments in other parts of the book.
REFERENCES


ABOUT THE AUTHOR

Charles Gasparovic is a biophysicist working in neuroscience; he is Associate Professor of Translational Neuroscience at the Mind Research Network, a non-profit organization focused on imaging technology and its emergence as an integral element of neuroscience investigation.

AUTHOR’S ADDRESS

Charles Gasparovic
c/o NCSE
PO Box 9477
Berkeley CA 94709-0477
info@ncse.com

Copyright 2014 by Charles Gasparovic; licensed under a Creative Commons Attribution-Non-Commercial-NoDerivs 3.0 Unported License. http://creativecommons.org/licenses/by-nc-nd/3.0/