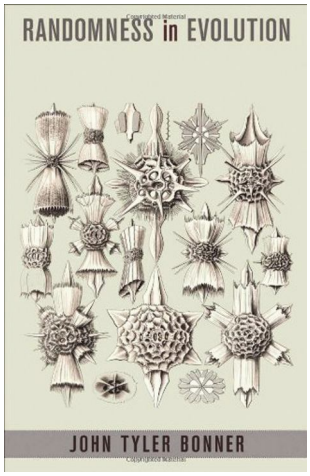

Randomness in Evolution. John Tyler Bonner. Princeton University Press, 41, William Street, Princeton, New Jersey 08450, USA. 2013. xi + 133 pp. Price: US$ 27.95.

Look for the Big Picture

At 90+ years of age, J. T. Bonner has done it again. He has written yet another brilliantly argued book. It has all the traits of Bonner's previous books – modesty, brevity and engaging style, but perhaps it is his most radical book. Bonner makes a bold case for randomness and an even bolder case against natural selection. True, he is restricting his attention to the morphology of small, microscopic eukaryotes. Nevertheless, it is a radical argument that is likely to be hugely controversial, not the least for emotional reasons. Bonner marvels at the exquisite morphological diversity of unicellular eukaryotes such as radiolarians and diatoms and notes that many diverse forms co-exist and have hardly changed over millions of years. He therefore speculates that these diverse morphologies are perhaps not the result of perfect adaptation to the environment shaped by the relentless action of natural selection, but simply random mutations floating around due to drift. But that is not the end of the story. His more powerful argument comes from an unexpected direction. He asks, following up on many of his previous books, why natural selection is so important in bigger, more complex higher organisms. Bonner has made some of the most powerful arguments, in this as well as his previous books, that higher, larger and generally more complex organisms need to go through an elaborate and sophisticated process of development that orchestrates many biochemical and cellular processes with great spatial and temporal precision. No errors can be tolerated in such a situation and the system is therefore greatly dependent on the relentless purifying action of natural selection to eliminate even mildly less-suited mutations. Now the flip side of this argument is that natural selection cannot be so important in producing simple microorganisms that do not go through such elaborately orchestrated development. In other words, it is the proposed relative absence of natural selection among simple organisms that makes the case for natural selection among complex organisms that much stronger.

Of course the perceived, and strongly defended, pervasiveness of natural selection in the design of all aspects of all living organisms is bound to raise not just eyebrows, but perhaps cudgels as well. But Bonner has a charmingly disarming style – he simply says that selectionists often tell just so stories, and 'My just so story is that no selection is involved and that they [the morphologies of unicellular eukaryotes] are all neutral phenotypes'. There is of course a profound message in this mutual accusation of telling just so stories, namely that each story, selectionist or neutral, is a null hypothesis, waiting to be tested. But the message that the jury is out would not be evident unless one countered the selectionist just so stories with neutralist just so stories, and that is Bonner's important contribution. Emotionally charged conflicts between selectionists and neutralists are not new in biology. In the 1970s we witnessed a long drawn-out battle between die-hard selectionists and the advocates of the neutral theory of molecular evolution[1]. In hindsight, the provocative labelling of the neutral theory of molecular evolution as 'non-Darwinian'[2] helped sharply polarize the two camps[3], but also led to relatively decisive resolution in favour of accommodating random genetic drift as an equally or more important causative agent of genetic variability. In recent decades we are witnessing a debate concerning the role of randomness and neutrality in shaping ecological species diversity, spurred by Steve Hubbell's book entitled *The Unified Neutral Theory of Biodiversity and Biogeography*[4]. And now a new controversy about the so called 'junk DNA' has erupted with claims on the one hand that less than 10% of the human DNA is evolutionarily conserved through purifying selection[5] and on the other hand that more than 80% of human DNA is functional (i.e. under selection)[6]. One must admit that there is a double irony in the often overstated criticism of neutralists by the die-hard Darwinians. First Darwin gave clear hints contrary to the claims of modern-day Darwinians, when he wrote in the sixth edition of the *Origin of Species*: 'I am inclined to suspect that we see, at least in some [cases], variations which are of no service to the species, and which consequently have not been seized on and rendered definite by natural selection. …Variations neither useful nor injurious would not be affected by natural selection, and would be left either a fluctuating element, as perhaps we see in certain polymorphic species, or would ultimately become fixed. …We may easily err in attributing importance to characters, and in believing that they have been developed through natural selection; … many structures are now of no direct use to their possessors, and may never have been of any use to their progenitors'[7]. Secondly, it is only because there are truly neutral stretches of DNA that we have a reliable molecular clock that permits us to build a robust evolutionary tree of life and confirm so many of Darwin's predictions!

It will be a while before the selection versus neutral controversy concerning ecological species diversity, 'junk DNA' and morphological diversity of unicellular eukaryotes is settled. In the meanwhile let us return to admire Bonner, the man. His life has been as interesting as the theories he proposes. Not surprisingly, the preface to this book is as interesting and thought-provoking as the book itself. The preface opens with the statement 'Many biologists, and I am one of them, live two lives at the same time. In one they work with organisms from day to day in the laboratory, or in the field. This is what keeps them in touch with their subjects – the real world that they find so fascinating. The other life is a concern for the big picture: how it all fits together'. He then goes on to say that no one is a better example of this than Charles Darwin, but after Darwin, I think no one gives a better example of the double lives of biologists than John Bonner himself. His secret seems to be that he retained his house in Nova Scotia

while working as a professor at Princeton University. Every summer, and the summers thankfully got longer after he formally retired from Princeton, Bonner drove to his Nova Scotia home with his typewriter (and later his computer) and looked for the big picture. He has been enormously successful not only in defining the big picture, but also in communicating it to a wide audience. The titles of his successive books, *Morphogenesis*, *Cells and Societies*, *The Evolution of Development*, *The Cellular Slime Molds*, *The Ideas of Biology*, *Size and Cycle*, *The Scale of Nature*, *The Evolution of Culture in Animals*, *The Evolution of Complexity*, *Life Cycles* (and more), tell a tale of relentless search for the big picture. But alas, Bonner tells a lie when he says that many biologists live two lives. Too few I would lament and much worse, we are bending over backwards to prove Bonner wrong. Today we put so much pressure on young biologists to publish far too many little papers in so-called high-impact journals, that they have no time to look for the big picture.

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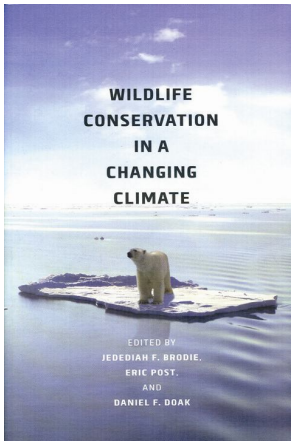

Wildlife Conservation in a Changing Climate. Jedediah F. Brodie, Eric Post and Daniel F. Doak (eds). The University of Chicago Press, London. 2012. 416 pp. Price: US$ 45.

Climate change has emerged as the environmental and ecological challenge of our times – our response to it will determine the fate of our species and that of many others on this planet. The field of wildlife conservation has in recent decades woken up to this specific challenge, with a slew of studies addressing the effects of climate change on wildlife populations. This book attempts to synthesize this body of work with the intent of focusing attention on the question 'What can we actually do about it?'

Given the vast and rapidly moving literature that they are dealing with, the editors of this book are to be congratulated for their stellar effort in bringing together a volume that addresses the subject from local to global scales and from species to community-level effects. Despite the very complex issues that are being addressed and diversity of the studies themselves, the book makes a credible attempt at synthesizing across the science and practice of conservation in a changing climate.

In a brief but succinct introduction, Brodie *et al.* (chapter 1) summarize elegantly why climate change today poses a different challenge to the Earth's species than it did in her deep history – the rates of climate change today are unprecedented compared to the past, and at the same time, these rapid changes are operating on wildlife populations that are already heavily impacted and constrained by human activities. The authors then highlight the limited use of popular niche modelling techniques as a predictive tool for future species distributions, and stress the importance of detailed data on species demography and species interactions in assessing and predicting the potential impacts of climate change.

The main body of the book is divided into three sections. In the first section, studies focus on the current and potential impacts of climate change on wildlife with a dominant theme being the exploration of different types of modelling approaches to the same. While Matthews *et al*. (chapter 4) explicitly incorporate shifts in demographic parameters into matrix models to predict future changes in populations of pond-breeding frogs, Fordham *et al*. (chapter 5) discuss range shifts in populations of an invasive vertebrate species using spatially explicit meta-population models. Where these kinds of intensive and long-term data are available, these modelling approaches have excellent predictive power. In chapter 7, Young *et al*. propose a 'climate change vulnerability index' that combines the use of natural history, distribution and climate data to assess which species are most vulnerable to climate change in a given region, but beyond its ability to quantify a common-sense judgements about which species are vulnerable, the actual utility of this index in management terms remains somewhat obscure.

The second section of the book deals with various case studies of the impacts of climate change on wildlife populations, at both guild and species scales. Owen-Smith and Ogutu (chapter 8) address the impacts of changing rainfall patterns on movements of ungulate populations in African ecosystems, with an important message being that future solutions must involve conservation outside protected areas where animal populations will wander as they track changing resource patterns. A similar theme is echoed by Le Galliard *et al*. (chapter 9), who consider the future of squamate reptiles in Europe, and call for increasing connectivity across the landscape between protected areas. The final chapters in this section are species-level case studies, with Ray *et al*. (chapter 12) suggesting that the American pika might simply run out of its mountain habitat as temperatures rise, while Tews *et al.* (chapter 13) call attention to the massive mortality impacts of stochastic extreme winters on populations of Arctic caribou. With both studies suggesting that there are no clear