Issues of analysis

Paul H. Harvey

Ecology and Natural History of Desert Lizards. By Eric R. Pianka. *Princeton University Press:1986. Pp.208. Hbk $45, £30; pbk $19.95, £13.30.*

FOR the past 20 years Eric Pianka has compared desert lizard communities in America, Africa and Australia, using standardized methods to allow comparisons among study sites within and between continents. The main results of his work are now brought together in a book which is not short on data; in addition to 31 pages of appendices, over 60 pages of the 150-page text are taken up by tables and figures.

Most of the book describes differences in reproductive tactics, activity and feeding habits of the various species, anatomical correlates of ecology, and community structure. The discussions are frequently based on statistical and multivariate summaries of the data. Such analyses can be dangerous, because hidden assumptions often lead to incorrect conclusions. Over the past ten years, there has been particular focus on this issue and Pianka is acutely aware of the pitfalls involved. Indeed, he devotes a full chapter to describing and assessing the methods used in the analysis of community structure. Most of his conclusions seem sound; for example, using a carefully designed "computer transplant experiment" Pianka and Larry Lawlor show that diets of particular species tend to change from site to site in a way that complements the diets of other species with which they are found.

Not all the analyses are as careful as this, however. At one point Pianka identifies what he terms a "transcendent" relationship. Some lizard species thermoregulate more effectively than others. The extent to which lizards thermoregulate can be described by their change in body temperature over a set range of air temperatures. But, at a set air temperature, some lizards are warmer than others. Pianka believes that these two components of the relationship between body and air temperature are not independent of each other, and plots the slopes relating body temperature to air temperature against their respective regression intercepts for a sample of 82 lizard species. He claims that the resulting highly significant negative relationship "represents an innate design constraint imposed by lizard physiology and metabolism". But, for given air and body temperatures, slopes and intercepts are not *expected* to be independent values: if we change the slope, we also change the intercept.

We clearly need to compare Pianka's data with a model in which slopes are independent of the air and body temperatures measured. To set up such a model, I randomly shuffled the empirical slopes among the different species and then calculated new intercepts using the mean external and body temperatures for each species. I repeated this procedure ten times and the correlation between slope and intercept ranged between −0.87 and −0.90, which to some extent describes Pianka's "transcendent" relationship. Pianka's relationship between slope and intercept may be tighter than expected, but he has not demonstrated that it is under a clearly defined null hypothesis. Indeed, his description leads the reader to assume that the expected correlation between slope and intercept is zero.

One chapter deals with reproductive tactics and, here again, I suspect that statistical analyses have missed their mark. Body size effects are either ignored or "removed" by taking simple weight ratios. Since larger species of most vertebrate groups are known to lay disproportionately small eggs (the relationship is one of negative allometry), Pianka's techniques are probably inappropriate and his analyses need to be repeated correctly.

Nonetheless, the book has considerable strengths. It is a rich source of unique data; it highlights our ignorance of factors influencing the structure of even relatively simple communities; and it documents excellent natural history observations of particular species. In addition, the text is enlivened by a delightful collection of superbly reproduced colour photographs illustrating the variety of species studied. □

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Technique in time

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Thermoluminescence Dating. By M.J. Aitken. *Academic: 1985. Pp. 359. Hbk £50, $59; pbk £30, $34.95.*

MARTIN Aitken's first book, *Physics and Archaeology*, published in 1961, contained only a page on thermoluminescence dating. This new book presents a stunning contrast.

In 1961 it was thought that thermoluminescence (TL) resulted from radiation damage due to α-particles emitted by naturally occurring uranium and thorium; we know now that it results from electrons becoming trapped at crystal defects as a consequence of their liberation by various kinds of radiation. The general idea of using TL to determine past radiation doses, and hence the ages of samples (using separate measurements of the dose rates), has been around for several decades. It was not, however, until Aitken took up the subject that real progress was made and reliable dates of practical value to archaeologists were obtained. Most advances in the technique originated in Aitken's own laboratory at Oxford, but description of them is spread over such a wide literature that we all welcome having them brought together in a single book.

In the first two chapters the basic principles and methods are outlined in language that anyone with a scientific training should be able to follow. Thereafter the reader will learn that the subject is riddled with complications. The archaeologist who has studied ^{14}C dating knows that here one has to measure only the $^{14}C/^{12}C$ ratio in order to calculate a date. In TL dating, on the other hand, the number and complexity of the problems that have to be taken into account is extraordinary. Non-linear TL response, differing TL sensitivities, inhomogeneous samples, varying water contents, radon escape and a host of other factors have to be coped with, and all of them are discussed in detail by Aitken. Some of these complexities can, however, be thought of as simply reflecting the great richness of TL dating, which now subsumes several different techniques (fine-grain, quartz inclusion, subtraction, pre-dose, zircon, etc.). Again, all are described thoroughly. Each chapter includes a page or more of "Technical Notes", where many useful details are given without interrupting the main text, while the book itself ends with 13 appendices, taking up 90 pages. These are an invaluable reference source which TL workers will often have cause to consult.

The shortcomings of the book are minor. Aitken admits to being biased towards research done at Oxford; here the book is naturally strong, but in consequence work done elsewhere receives less thorough treatment. My main criticism, however, is reserved for a lack of rigour at some points and for Aitken's use of units. An "ionized electron" (p.42) is not part of my vocabulary, and reference to the activity of potassium as 89.5 per cent beta and 10.5 per cent gamma will confuse the unwary. "Annual dose" is used where "dose-rate" is meant, R is used for α-particle range in units of length on p.299 and units of mass per unit area on p.300, and a sievert can no more equal a gray than a digested apple can equal a fresh one. These and others like them are not too serious, though they will puzzle those not sure of their science.

This is a book by a physicist for physicists, and an essential acquisition for any TL dating laboratory and library. It will be the standard reference for many years. □

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