

Review of the book *Quantitative Paleozoology*, by R. Lee Lyman

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2011

Canadian Zooarchaeology / Zooarchéologie canadienne

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Original citation:

Stewart, F.L. (2011). [Review of the book *Quantitative Paleozoology*, by R. Lee Lyman]. *Canadian Zooarchaeology*, 27, 23-28.

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Book Review

Quantitative Paleozoology

R. Lee Lyman (2008)

Cambridge Manuals in Archaeology, Cambridge University Press
ISBN 978-0521887496 (hardback); 978-0521715362 (paperback)

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Seldom have I enjoyed so much such a difficult book as R. Lee Lyman's *Quantitative Paleozoology*. Reading and re-reading the chapters in this book was like attending lectures in a course on "Statistics for Paleozoology" from a demanding professor who explains difficult concepts well. Because I have benefited so much from this text, I want to let others know about it — hence, this review. As Lyman notes, the topic of reliable quantification of animal remains is of great interest to both palaeontologists and zooarchaeologists, and examples from both their fields of study occur throughout this text.

If the title seems familiar, that is because, as Lyman explains in his preface, his 2008 book covers the same ideas as Donald Grayson's *Quantitative Zooarchaeology*, published in 1984. However, Lyman's book is much more than a mere revision of that classic and I suspect that, like its predecessor, it will be a standard reference for many years to come.

The first of eight chapters is titled "Tallying and Counting: Fundamentals".

Terminology and definitions are covered in this chapter. For example, Lyman recommends using the word "element" for complete discrete anatomical units, such as a whole bone, tooth or shell, and the word "specimen" for fragments or portions of bones, teeth or shells. This follows what has become general practice for many zooarchaeologists, and I agree with Lyman's suggestion that we all adopt this. The highlight in this chapter is the section on *Mathematical and Statistical Concepts*. Lyman gives a very good explanation of four distinct scales of measurement: nominal, ordinal, interval, and ratio. The examples he uses to illustrate these are excellent. Equally important in this chapter is the introduction of the concepts of *measured* and *target* variables. The relationship between these two is a recurring theme in the book. This chapter, like most of the others, is concluded with a summary discussion of the ideas in it. There is also a final section introducing faunal material from owl pellet samples and mammalian faunal remains from two archaeological sites. These are used throughout the book to illustrate various quantitative methods.

Chapter 2 on “Estimating Taxonomic Abundances: NISP and MNI” is the longest one. (Lyman would probably give the page numbers for all the chapters and a test to show that this chapter is significantly longer than any of the others.) This chapter repeats much of what Grayson (1984) wrote. Remembering Lyman’s deep interest in taphonomy, it is not surprising that he begins this chapter with a discussion of the various altering stages that skeletons experience after death. Unfortunately, in my opinion, Lyman chooses to use obscure names for these stages rather than ones that have been in common usage for a long time. For example, Clark and Kietzke’s (1967:111) and Klein and Cruz-Uribe’s (1984) “life assemblage” is Lyman’s “biocoenose,” and similarly difficult terms are applied to each of the other stages that a skeletal element goes through from the time of death until it is excavated by an archaeologist or a palaeontologist. When these terms were used later in the book, I found that I had to flip back looking for their meanings. This is a small criticism, and the terms are included in the glossary at the end of the book.

NISP and MNI as quantitative units have been discussed often in the literature, and many of the problems associated with each of them are familiar. Like Grayson before him, Lyman gives a good summary of their uses and then adds more reasons for the use of NISP as opposed to MNI. He includes many examples in this chapter, and these are nicely illustrated with detailed tables and figures to exemplify his main point that MNIs are derived

from NISPs, and therefore provide no new information. He returns to topics outlined in the first chapter and concludes that both NISP and MNI are ordinal scale measurements only. Secondly, he finds that much of the disagreement about their usefulness has stemmed from a lack of precision in defining the target variable that is being sought. In our target values, zooarchaeologists are usually trying to determine what the people ate (Lyman’s taphocoenose) whereas palaeontologists, including those studying the first humans, more often are those trying to reconstruct what was available in the environment for humans to hunt or scavenge (Lyman’s biocoenose). Lyman emphasizes that we must be very clear about what we are trying to establish (our targets). This chapter requires very careful reading but the examples assist the reader in understanding the concepts presented.

One crucial definition in Chapter 2 surprised me. Lyman defines NISP as the “number of skeletal elements (bones and teeth) and fragments thereof – all specimens – identified as to the *taxon* they represent” (p. 27, emphasis added). I originally read this and agreed, thinking I knew what NISP meant. It was only in a later chapter (see below) that I realized Lyman defines NISP as the total of those remains which could be identified to taxon rather than the total number of all of the specimens in the sample, which is how I have used the term. My experiencing this difference farther along in my reading emphasized to me the importance of carefully disclosing how we are using even supposedly well-known terms in

our publications. I personally prefer defining NISP as the total number of specimens in the sample because it avoids the issue of different analysts being able to identify more or less of the total sample. We can all count up the specimens but some of us are better than others at identifying them to class, to family or more precisely.

Expanding on his discussion of quantification using NISP or MNI, in Chapter 3, “Estimating Taxonomic Abundance: Other Methods”, Lyman reviews other methods. He begins with a consideration of estimating biomass. He shows that, in addition to the problems inherent in MNI, when an analyst decides to multiply the average meat weight of a taxon by its MNI, there is the added problem of determining a correct *average* meat weight. Trying to avoid these problems, some researchers have turned to total bone weights to compare taxa. But bone weights are not similar across classes or species for similar volumes of bone. In fact, we use these differences to help us identify the specimens initially. Lyman next discusses using bone size to establish total body size (allometry) and also finds this procedure lacking. The question of pairing bones to establish the number of individuals represented in a collection could have been included in the previous chapter, but is covered here. I have tried to do this with archaeological beaver bones and agree with White and Lyman that this procedure is both too time consuming and too fraught with possible mismatches to be useful. In the discussion at the end of this chapter, Lyman

concludes that the best quantification measure to use is NISP.

Chapter 4 is on “Sampling, Recovery, and Sample Size”. I found the first half of this chapter was easy reading but the second was more challenging. Most of us are very familiar with the effects that different recovery methods, particularly the various screen mesh sizes, have on the faunal samples that we study. Lyman does a nice job of covering this topic, although I was surprised that he did not include flotation here. He includes an interesting discussion of ways to correct for differential loss due to different excavation methods and gives formulas for this. Unfortunately, Lyman argues, these are not very useful because they require the assumption that faunal remains are distributed evenly across a site and most often this is not the case.

Perhaps of greater interest in this chapter are his considerations of comparing samples of different sizes (using rarefaction which is reducing the large sample to a smaller size) and of sampling to redundancy. There are computer programs to help with the first of these issues. For the second, Lyman shows how NISP figures compared to volume excavated can be graphed, and he provides graphs for actual samples to demonstrate this. When the curve levels off, you are no longer gaining new information. As Lyman admits, this could be difficult to use in the field, as faunal specimens generally are not identified and analyzed there, but it could be used in the lab. Once no new information is being derived from the identifications, then they can cease,

saving time and money rather than continuing on to finish up a complete sample when no new information is being generated. Again, the analyst would have to keep checking to determine this breaking point. This is not a new idea and many have sampled large fauna collections (mainly to save on time and money) but Lyman's coverage of the topic makes employing it very convincing. Finally in this chapter, Lyman discussed "nestedness," which is a way of determining if samples of different sizes might have been derived from the same underlying population. This concept has been developed by biologists comparing island chain populations and does not seem to be as useful to archaeologists.

"Measuring the Taxonomic Structure and Composition ("Diversity") of Faunas" is the title of Chapter 5. I found that the definitions stated at the beginning of this chapter needed rereading because I was unaccustomed to his use of the term "diversity". For Lyman, diversity "signifies the structure and composition of a fauna" (p. 176) which include the particular taxa represented, the total number of taxa represented (i.e., the richness of the sample), and the number of specimens within each taxa (i.e., the taxonomic evenness of the sample). Diversity has been used in the past by many zooarchaeologists to indicate the combined number of taxa and the number of individual specimens in those taxa, but here Lyman uses the term "heterogeneity" for that concept. In this chapter, the variables making up diversity are considered and quantitative indices for each of these variables are

discussed, beginning with the number of identified taxa for which Lyman uses the abbreviation NTAXA. This is followed by a discussion of the "Indices of Structure and Similarity," beginning with the simplest, taxonomic richness, and proceeding through taxonomic composition and taxonomic heterogeneity to taxonomic evenness. These sections are well illustrated with tables and graphs which assist in the comprehension of the occasionally difficult concepts. In zooarchaeology, taxonomic abundances in samples are used to answer basic questions regarding diet, and comparisons are often made between spatially discrete units at a site, over time on one site or between and among sites. Using the methods explained in this chapter, the validity of such comparisons can be enhanced. Lyman ends the chapter by reminding researchers that they must be clear about what they are comparing and how area or time is being conflated in the comparisons.

Closely related to the issues covered in Chapters 2 and 3, MNE (the minimum number of elements) is the topic of Chapter 6: "Skeletal Completeness, Frequencies of Skeletal Parts, and Fragmentation". Lyman's review of the history of MNE shows that the concept was first used by taphonomists (specifically Voorhies in 1969) who were most concerned with explanations of assemblage formation and why some elements were more common in a collection than others. The same disproportionate numbers of particular animal bones interested Binford and others (Binford and Bertram 1977 and

several Binford publications from 1978 on, cited by Lyman).

A problem which arises with MNE is how the values are derived, and Lyman shows that many different methods have been employed in the past, including even using GIS imaging which in Lyman's trials was unsuccessful. Obviously, once again clear explanations must be given in reports about the way MNE is determined. Because MNE is really just a variant of MNI, all of the weaknesses (sample size, aggregation, and definition) in the latter apply to the former, and MNE is an ordinal scale measurement only. This is nicely demonstrated with skeletal part numbers of zooarchaeological deer and wapiti and graphs using those figures.

Lyman next discusses Binford's introduction of MAUs ("Minimal Animal Units") as an attempt to standardize the MNEs by dividing the observed number of elements by the number of times that element occurs in the complete skeleton. Often the MAU figures are normed by "dividing all MAU values by the greatest observed MAU value in a particular collection and multiplying each resulting value by 100" (p. 234) which aids in comparisons. Several other methods for standardizing MAUs have been devised and Lyman reviews these as well as Shotwell's failed attempts to accurately measure skeletal completeness. Although MNE has been used in attempts to measure skeletal part abundance, skeletal completeness and bone fragmentation, Lyman concludes that it is not valid for any of these targets. He does allow that determining

MNE might be of interest when one element is more fragmented than another. This would become apparent in the differences between the pairs of NISP and MNE figures for the elements. Lyman goes on to argue that if the two values are strongly correlated then it is better to use NISP numbers. He does not comment on the opposite condition - if the two values are not correlated - but rather he reiterates the inherent problems with MNE. If we abandon both MNI and MNE, as Lyman recommends, how do we let readers of our reports know that, in one or more of the totals in our NISP column of represented species, there is a disproportional number of specimens from one element?

Not surprisingly, considering Lyman's extensive research on taphonomy, including his oft-cited, comprehensive book on this topic (Lyman 1994), the second last chapter of this text is "Tallying for Taphonomy: Weathering, Butchering, Corrosion, and Butchering." Lyman begins this seventh chapter with a nice definition of a taphonomic *signature* which is "a modification feature evident on a skeletal part that is known (or believed) to have been created by only one process or agent... It is a signature because it is unique to that agent or process." (p. 264). The signatures considered in this chapter include those caused by weathering, chemical corrosion, mechanical abrasion, burning, gnawing and, finally and in greatest detail, butchering. Methods for tallying these marks and the many associated pitfalls are discussed.

In this chapter Lyman introduces two more acronyms and so highlights a problem with the definition of NISP mentioned above. The new acronyms are: *NSP* for the number of specimens and *NUSP* for the Number of Unidentified Specimens. He gives this equation, $NISP = NSP - NUSP$. I have always used NISP to mean the total number of *individual* specimens in a sample or Lyman's NSP and have listed his NUSP figures in my tables and given them as a percentage of the total sample in the introduction to a report. I wonder if I am alone in this? In any case, this certainly highlights a main theme of the book which is to be sure we have given precise definitions for the terms we use to describe our faunal samples. I was also somewhat surprised to read that few people give NUSP. I agree the acronym is not in general use but many reports do include the number and percentage of unidentified specimens for the total sample and within classes too.

In the last short chapter, Lyman offers his "Final Thoughts". Here he reviews the main points of the book ending with a repeated caution for researchers to be explicit in the identification of their target variables and then to take into account how the variable they measure either does or does not actually reflect the magnitude of the target variable. The explanations in the body of this text will help researchers to do just that.

This book ends with a useful, three page glossary, 30 pages of references and an index. Thus, in addition to the excellent explanations within this text itself, there are many more sources provided for the reader to consult.

I borrowed this book from the library but, halfway through reading it, realized that I wanted my own copy. I imagine returning to it often in the future and recommend its purchase to you.

References Cited

- Binford, L.R.
1978 *Nunamiut Ethnoarchaeology*. Academic Press, New York.
- Binford, L. R. and J. B. Bertram
1977 Bone frequencies and attritional processes. In *For Theory Building in Archaeology*, edited by L. R. Binford, pp. 11-153. Academic Press, New York.
- Clark, J. and K. K. Kietzke
1967 Paleocology of the Lower Nodular Zone, Brule Formation, in the Big Badlands of South Dakota. In *Oligocene Sedimentation, Stratigraphy, Paleocology and Paleoclimatology in the Big Badlands of South Dakota*, edited by J. Clark, J. R. Beerbower and K. K. Kietzke, pp.111-137. Fieldiana: Geological Memoirs, Volume 5, Field Museum of Natural History.
- Grayson, D. K.
1984 *Quantitative Zooarchaeology. Topics in the Analysis of Archaeological Faunas*. Academic Press, Orlando, FL.
- Klein, R. G. and K. Cruz-Uribe
1984 *The Analysis of Animal Bones from Archaeological Sites*. University of Chicago Press, Chicago.
- Lyman, R. L.
1994 *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.
- Voorhies, M. R.
1969 *Taphonomy and Population Dynamics of an Early Pliocene Vertebrate Fauna, Knox County, Nebraska*. University of Wyoming Contributions to Geology Special Paper No.1, Laramie.