



The Dinosauria (second edition)

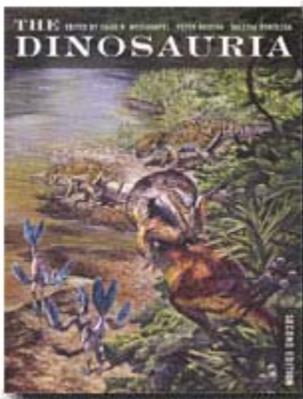
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edited by David B. Weishampel, Peter Dodson, and Halszka Osmólska
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INTRODUCTION

The Dinosauria (second edition) is the long-awaited update of the 1990 volume of the same name (Weishampel et al. 1990a), which in the past fourteen years has become a fixture on the desks and shelves of dinosaur paleontologists and enthusiasts worldwide. In many ways, that first edition was the first of its kind (as the editors themselves noted; Weishampel et al. 1990b), presenting what was the only truly comprehensive, research-based guide to dinosaurs written by scientists.

This second edition is faithful to the first in many ways. All of its good qualities are still apparent; some have been improved. Certain crimes and misdemeanors have been eliminated; a few still lurk the pages. It has also been updated to within an inch of what publishers will allow; indeed, some 2003 papers must have snuck in under the cover of editorial night. And at \$95, this substantial hardcover volume is, in fact, a bargain.



But really, you don't need me to tell you this. *The Dinosauria (second edition)* is the kind of book that most paleontologists, or at least most vertebrate paleontologists, will buy. And they will not be disappointed for doing so, because this edition succeeds in the same ways as the first, and enjoys some new accomplishments as well. Nonetheless, a great deal of effort went into producing this book, and it deserves (or, if you prefer, is not excused from) a proper review.

THE MORE THINGS CHANGE...

Several substantial improvements merit comment early on. Perhaps the most important, rightly emphasized in the introduction (Weishampel et al. 2004), is the editors' insistence that (1) all authors present a phylogeny of their respective groups that is (2) backed up by a formal cladistic analysis and (3) made available on the book's website. With this one editorial fiat, Weishampel et al. have completely transformed the systematic portion of *The Dinosauria* from a series of op-ed pieces into scientific contributions that can be properly evaluated by the paleontological community.

A second major improvement is the expansion of the non-systematic section of the book ("Dinosaur Distribution and Biology"). The first edition included chapters on the paleobiology of sauro-

Pods and Carnosaurs (but no other specific groups), a list of dinosaur distributions, and then collapsed everything else into “dinosaur paleobiology”. Here in the second edition, there are separate chapters on taphonomy, extinction, physiology (two), and biogeography. They are also properly placed after the systematics section.

Of all the major and minor changes to the book, I cannot think of one that detracts from its value, or renders it worse than its predecessor. If that seems like damning with faint praise, it isn't. The editors are to be commended for resisting the temptation to “improve” the book to death.

...THE MORE THEY STAY THE SAME

Not all of the book's positive aspects are new; in fact, several are wise holdovers from the first edition. In that volume, three things stood out as particularly useful for both scientists and students: (1) an extensive bibliography, not complete but close enough, and salted with enough obscure citations for anyone's taste; (2) a similarly exhaustive list of dinosaur taxa, with provenance information (where available) and taxonomic opinions; and (3) maps and a lengthy compendium detailing the geographic distributions of dinosaurs.

All three are, happily, still included in the second edition, each appropriately expanded and updated. I say “happily” because these three form the absolute bedrock of the book. *The Dinosauria (second edition)* is a summary and interpretation of the current state of knowledge in dinosaur science, and as such does not (and should not) attempt to amass the vast amounts of primary data on which the science is founded. What it does (and should do) instead is provide a comprehensive means for readers to access those primary data through the original publications.

At the same time, one might wonder why certain other aspects of the first edition were not changed. In an attempt to strengthen the intellectual continuity between the two editions, the editors have chosen to retain as many original authors as possible. Updates were primarily accomplished by the introduction of one or two new (usually junior) authors to each chapter. Often enough, the result is a responsible update rather than a complete overhaul. For certain chapters, however, the original author choices seemed less-than-ideal back in 1990, and now appear downright baffling.

The first edition's disparity in taxonomic coverage also continues. Although psittacosaurids have now been folded into “Basal Ceratopsia”, and non-hadrosaur ornithomimids are somewhat more rationally grouped, other biases remain. Sauropods are

still absurdly lumped into a single chapter, which is now the longest in the taxonomic section (64 pp.), when they should have been split into at least three groups (basal Sauropoda, Macronaria, and Diplodocoidea). The most egregious bit of over-inflation is still the hopelessly charismatic Theropoda, encompassing a lavish nine chapters and 176 pages! I understand the group's popularity and appeal (I work on them myself), but in the end paleontologists have directed too much energy into theropod studies at the expense of every other dinosaur group. Yes, many theropods were spectacular and ferocious, and yes, the group did give rise to birds. But in a less slavering and progress-obsessed world, these nine chapters would have been five: basal Theropoda, basal Tetanurae, basal Coelurosauria, Maniraptora, and basal Avialae.

Another major critique of the first edition centered on the quality and variability of its illustrations. Although several of the second edition's chapters have fine illustrations (Langer and Tykoski should be singled out here), others have recycled previous images at an unfortunate rate (Figure 1). Finally, while the inclusion of web-access data matrices for the phylogenetic and biogeographic analyses is a tremendous improvement, more effort could have been made to support the non-systematic chapters. Although the dinosaur distributions data (ddd) are available on-line, the URL is not listed in the book or on the Press website (it's ddd). Likewise, a downloadable version of the bibliography would be a real gift to the paleontological community.

GESTALT OR SYNERGY?

At this point I am expected to deliver a chapter-by-chapter commentary on *The Dinosauria (second edition)*, and detail its successes and shortcomings. In a way this is impractical, because were I expert enough to critique the lengthy morphological descriptions of (e.g.) stegosaurs I might have considered writing the book myself. (I am not, and did not.) Therefore, I present a more general discussion of content here (see Table 1 for chapter listing).

The introduction (Weishampel, Dodson, and Osmólska) outlines the changes and updates to the new edition, including the web address for data matrices (<http://www.ucpress.edu/books/pages/2601001/2601001.supplement.html>). The authors also repeat their 1990 exhortation to standardize anatomical nomenclature. The logic is, apparently, that enough confusion arises from the peculiarities of human anatomical terminology to warrant man-

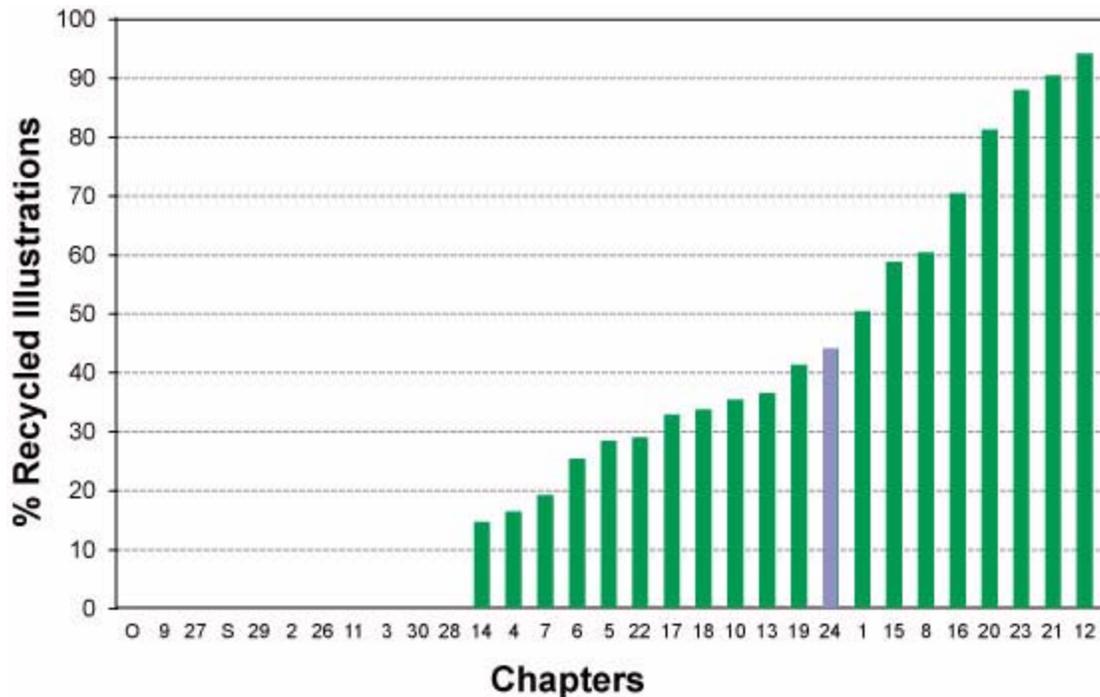


Figure 1. Illustration renewal and recycling in *The Dinosauria* (second edition). The graph shows the number of recycled illustrations as a percent of all illustrations, according to chapter. Chapters are numbered as in the book, except for the two introductory chapters: Saurischia (S) and Ornithischia (O) (see Table 1). Systematic chapters are in green, non-systematic chapters are in purple; chapter 25 (taphonomy) has no illustrations and is excluded.

datory use of *both* veterinary and avian terms instead.

Here I would like to digress and point out that the most logical course of action is to choose a nomenclature that is both maximally useful and maximally inclusive. Combining terms from a highly derived crown group possessing numerous autapomorphies (i.e., birds) with terms from a polyphyletic assemblage of tetrapods unfortunate enough to fall under the human yoke (i.e., domesticates) does not fulfill these requirements. It has the added misfortune of substantially altering existing nomenclatural systems. In a more Orwellian world, such changes would be of little consequence, because they would immediately inspire armies of workers to erase all previous mention of outdated terms and meanings from the literature. But alas, this is not so. Any significant changes will always require maintenance of the old terminology if the previous two centuries of literature is to remain digestible to researchers and (especially) students.

A simpler solution would be to retain the dominant terms “anterior” and “posterior” (not “cranial” and “caudal”) in their standard vertebrate (not human) usage. This would correspond to a primary developmental axis and thus apply homologously to *all bilaterian organisms*, not just

craniates. Furthermore it would provide greater congruence with more of the existing literature. Multiple but equivalent terms that depend on location relative to the head (e.g., “cranial” versus “rostral”) presume not only the greater anatomical “importance” of the head, but that some benefit is gained by such terminological proliferation. What benefit? Is the term “anterior” so confusing that it obscures even the *region of the organism* under discussion? Our conversations about nomenclature should focus on conservatism, inclusiveness, and the base of the tree, not the crown.

As before, the book’s introduction is followed by Benton’s chapter introducing the origins of dinosaurs and their relationships to other archosauromorphs, which doubly serves as an introduction to the cladistic nomenclature that is now standard within the volume. Holtz and Osmólska then introduce the Saurischia with a brief synthesis of the following dozen chapters; Weishampel later does the honors for the ten chapters covering the Ornithischia.

These 22 systematic chapters outline all significant aspects of dinosaur morphology in great detail, providing a very useful set of descriptions that together form an accurate assessment of the current state of knowledge for these groups. The accompanying analyses are as varied as the

Table 1. Chapters in *The Dinosauria* (second edition).

Chapter	Author(s)	Title
1	Benton	Origin and relationships of Dinosauria
S	Holtz and Osmólska	Saurischia
2	Langer	Basal Saurischia
3	Tykoski and Rowe	Ceratosauria
4	Holtz, Molnar, and Currie	Basal Tetanurae
5	Holtz	Tyrannosauroidae
6	Makovicky, Kobayashi, and Currie	Ornithomimosauria
7	Clark, Maryanska, and Barsbold	Therizinosauroidae
8	Osmólska, Currie, and Barsbold	Oviraptorosauria
9	Makovicky and Norell	Troodontidae
10	Norell and Makovicky	Dromaeosauridae
11	Padian	Basal Avialae
12	Galton and Upchurch	Prosauropoda
13	Upchurch, Barrett, and Dodson	Sauropoda
O	Weishampel	Ornithischia
14	Norman, Witmer, and Weishampel	Basal Ornithischia
15	Norman, Witmer, and Weishampel	Basal Thyreophora
16	Galton & Upchurch	Stegosauria
17	Vickaryous, Maryanska, and Weishampel	Ankylosauria
18	Norman, Sues, Witmer, and Coria	Basal Ornithopoda
19	Norman	Basal Iguanodontia
20	Horner, Weishampel, and Forster	Hadrosauridae
21	Maryanska, Chapman, and Weishampel	Pachycephalosauria
22	You and Dodson	Basal Ceratopsia
23	Dodson, Forster, and Sampson	Ceratopsidae
24	Weishampel, Barrett, Coria, Le Loeuff, Xu, Zhao, Sahni, Gomani, and Noto	Dinosaur distribution
25	Fiorillo and Eberth	Dinosaur taphonomy
26	Fastovsky and Smith	Dinosaur paleoecology
27	Holtz, Chapman, and Lamanna	Mesozoic biogeography of Dinosauria
28	Chinsamy and Hillenius	Physiology of nonavian dinosaurs
29	Padian and Horner	Dinosaur physiology
30	Archibald and Fastovsky	Dinosaur extinction

authors, and it is beyond the scope of this review (and the expertise of this reviewer) to critique them individually. The on-line matrices allow any vertebrate paleontologists to perform that duty themselves.

Subsequently, the book presents seven chapters covering all non-systematic aspects of dinosaur science. The chapter on dinosaur distributions (Weishampel et al.) is first, organized by time period, country, geographic region, and finally formation. The list is impressive and as close to exhaustive as can be expected. It provides a glimpse into the sampling patterns of dinosaur discovery, and suggests important regions and time period that need further exploration. Strictly speaking, the data need to be more finely resolved (i.e., to the level of actual locality) before in-depth analyses can be performed, but the authors could have presented more summarization in the chapter. As it stands, they indicate only the number of locations per continent per time period, and the percent increase over the number reported in 1990.

Dinosaur taphonomy (Fiorillo and Eberth) is dealt with in a short chapter that introduces both taphonomy and its place in dinosaur studies. It is brief but dense, and could have been longer and better illustrated. The authors have actually done a fine job of summarizing nearly every relevant paper on dinosaur taphonomy, and the chapter's brevity reflects the comparatively recent development of the subject and the small number of working specialists.

Dinosaur paleoecology (Fastovsky and Smith) is also covered briefly, but in this case the reason is less clear. The chapter primarily presents an uneven discussion of feeding categories, wherein herbivory is addressed in terms of coevolution, and carnivory in terms of "morphotype". Much of this is an accurate and welcome synthesis, but several topics are omitted, including Farlow's extensive work on energetics, body size, and home ranges.

The chapter entitled "Mesozoic Biogeography of Dinosauria" (Holtz, Chapman, and Lamanna) is less a synthesis than a study of its own, and the only non-systematic chapter to present original analyses accompanied by original data. The authors use cluster analysis and ordination to examine taxonomic similarities between different geographic regions and time intervals. Their result is, in their own words, a "first attempt," and reveals not only interesting patterns but underscores the need for a quantitative assessment of sampling effects and other biases on the dinosaur fossil record.

Two chapters (one by Chinsamy and Hillenius, another by Padian and Horner) detail the ongoing controversy surrounding dinosaur physiology. Here the editors have chosen to present two sides of the discussion rather than what would have been a very artificial single summary. The result is predictable: each chapter brings both depth and breadth to the topic, is well-illustrated, quite authoritative, and completely contradicts the accompanying chapter. This is a welcome and reasonably accurate presentation, one that clarifies several points and will likely stimulate further research.

The book concludes (literally and figuratively) with a fine chapter on dinosaur extinction (Archibald and Fastovsky). Much of the immediate heat has gone out of this debate, and thus the chapter is a considered review of the current thinking, combining the authors' own expertise with the diverse research of other workers, and highlighting controversies and questions that still remain after more than two decades of concerted study. The North American-centered view of the terrestrial aspects of the K/T extinction is an important point emphasized by the authors.

The above summary actually obscures the main strength of the volume: it is extremely data-rich. As dinosaur science has moved away from authoritarianism and toward testability, it is not authorial opinion but information that is valued. Whether any one author presents the optimum view is only partly relevant; the fact that the data are presented *en masse* makes this book an invaluable reference work regardless.

In addition, it is hard to single out any one chapter as being far better or worse than the others. This is a significant achievement given the diverse assemblage of authors (43 in total; Table 1). Most edited books have a nearly operatic range in both quality and style. The relative evenness of *The Dinosauria (second edition)* is a sign of good editorial stewardship, and means that the reader may expect few oversights or significant gaps in coverage.

SIGNS OF THE TIMES

I believe that most of this is derived from the nature of the book itself. Fifty years ago, this would have been a very different volume—assuming that anyone would have thought dinosaurs a worthwhile-enough group to bother with in the first place (and many certainly didn't). But certainly it would have been written by a single author, resulting in much greater uniformity, especially with regard to

taxonomic opinions and morphological descriptions.

Such a single-authored volume on dinosaurs would be useful, but our field has perhaps changed too much to produce it. Carroll (1988) was probably the last to attempt anything comprehensive in this vein for fossil vertebrates. In truth we no longer train students in this way, combining the depth of knowledge seen in ornithology or herpetology with traditional paleontological breadth. Specialization is the order of the day. One result can be a better understanding of detail, but often this comes at the expense of the broader view.

This can be seen in the chapters of *The Dinosauria (second edition)*, where the authors' own works tend to form the core of each chapter's references (Figure 2). By contrast, the same authors are much less frequently cited in other chapters (Figure 3). An interesting correlative trend is the tendency toward a greater discrepancy between these factors in the non-systematic chapters. Presumably this is because synthetic papers (1) rely less on descriptive morphology than do systematic papers, and so cite them less often; and (2) are themselves less utilized in systematic works, and so are cited by them less often.

The changes evident between the two editions of *The Dinosauria* are important because they reflect underlying changes in the state and success of dinosaur science. In its most literal sense, this can be evaluated by the tremendous number of new taxa (more than 200; Weishampel et al. 2004), increased phylogenetic resolution and standardization of techniques, and better temporal and geographic sampling of the dinosaur record.

But more importantly, the stronger presence of non-systematic studies signifies a shift toward data analysis and synthesis beyond mere phylogenetic reconstruction. In 1990 the field of dinosaur paleontology was still racing to embrace the cladistic renovations introduced just a few years previously (e.g., Gauthier 1986; Sereno 1986). Today nearly every single dinosaur taxon has either been placed into a phylogenetic analysis, or specifically excluded from one—in other words, a conscious scientific decision has been made regarding the phylogenetic status of almost every known dinosaur.

That is a tremendous accomplishment for less than two decades' work, and will prove immensely liberating to scientists and students as they develop new research programs. The non-systematic chapters in this volume are the first fruits of such programs, but they will also serve as benchmarks, just as early phylogenetic studies did in the first edition. That some of these chapters seem

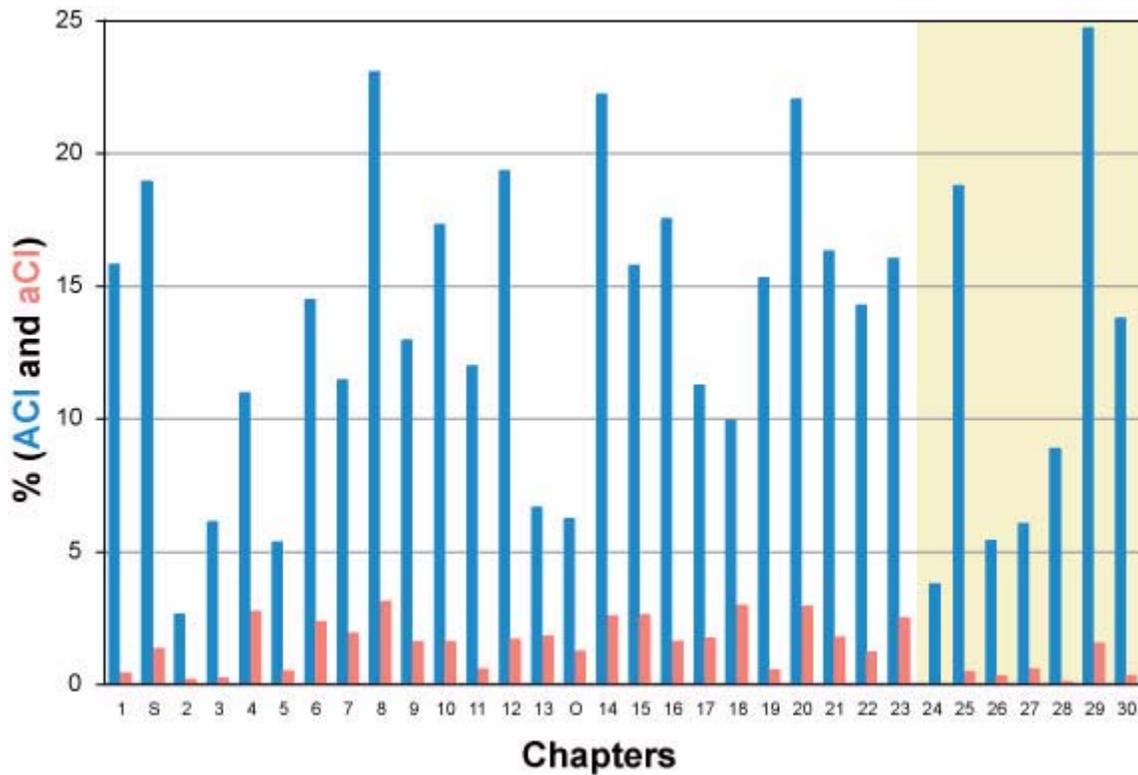


Figure 2. Citation patterns in *The Dinosauria* (second edition). Blue bars show the autocitation index (ACI), expressed as the percent of cited references in the text of each chapter that were written by that chapter’s author(s). Red bars show the allocitation index (aCI), the percent of all other references in all other chapters written by those same authors. (Note that the aCI for authors increases by 1 per reference, but only by 0.5 if that reference includes authors of the citing chapter as well.) The yellow area highlights the non-systematic section of the book. Chapters are labeled as in Figure 1. The aCI = 0 for Chapter 24 (dinosaur distributions); citations in this chapter are confined to tables and not tallied here.

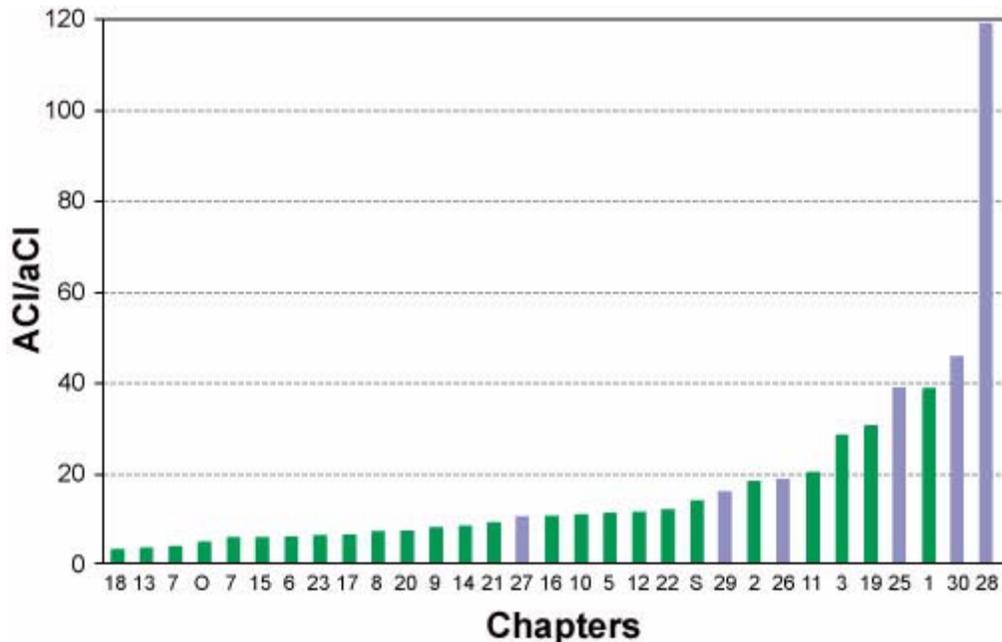


Figure 3. Auto- versus allocitations in *The Dinosauria* (second edition). The graph shows the ratio between the two values in Figure 2 (ACI/aCI). High values indicate a large discrepancy between the ACI and aCI. Systematic chapters are in green, and non-systematic chapters are in purple. Chapters are labeled as in Figure 1; chapter 24 is omitted because its aCI = 0.

abbreviated or combative is not terribly relevant; their importance is that they no longer exist merely to decorate systematic studies.

This shift toward synthesis and broad-scale analysis is healthy, and bodes well for the future of dinosaur science. After all, why else do we bother discovering the systematic relationships of organisms if not to learn about more complex biological, ecological, and evolutionary processes?

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