

Hindsight
makes
better
foresight:

PALEONTOLOGY AS A NEW TOOL FOR CONSERVATION

By Dan Chure, Ph.D.

"In this chapter, we consider what ought to be paleontology's most vital calling: use of the vast record of life's prehistory to help understand and conserve its threatened descendants."

—Archer, Hand, and Godthelp

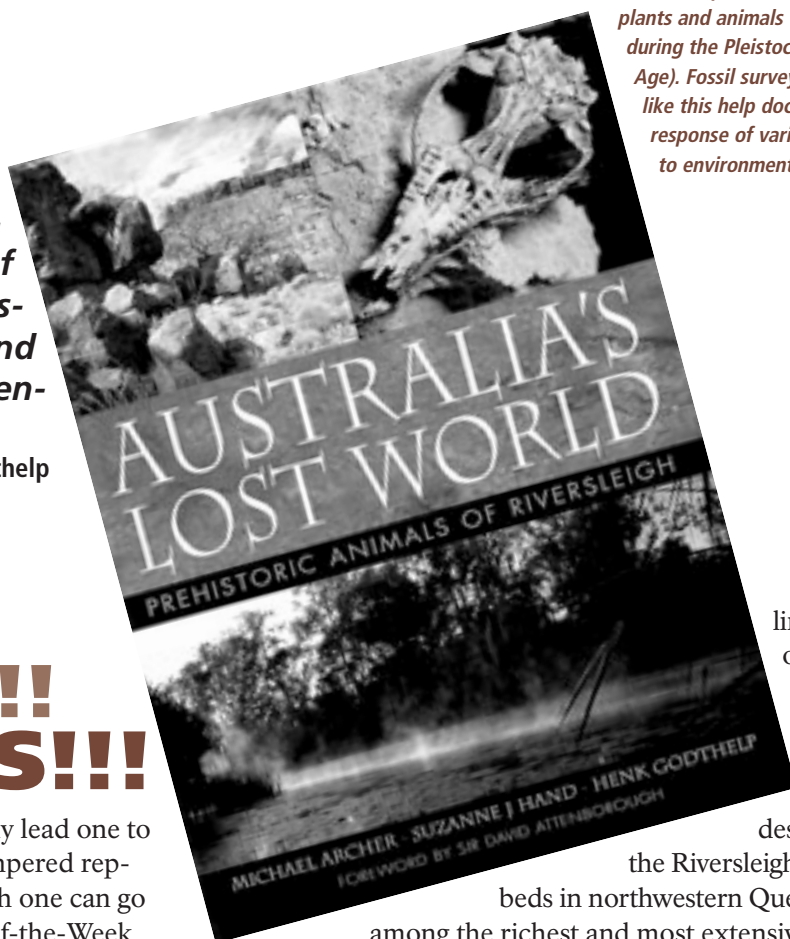
DINOSAURS! DINOSAURS!! DINOSAURS!!!

TV, movies, and popular books could easily lead one to believe that those huge, brooding, bad-tempered reptiles were the only life of the past. Although one can go broke subscribing to the Dinosaur Book-of-the-Week Club, there are some other popular books that focus on the many other wonderful creatures that have populated our planet over the past millennia. These non-dinosaur books introduce us to past life otherwise still buried in the pages of scientific journals.

The recently published book *Australia's Lost World: Prehistoric Animals of Riversleigh* by Mike Archer, Suzanne Hand, and Henk Godthelp (2000) adds to the



Figure 1. Caves like this one at Glen Canyon National Recreation Area often preserve fossils of plants and animals that lived during the Pleistocene (Ice Age). Fossil surveys at sites like this help document the response of various species to environmental change.



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describes the Riversleigh fossil beds in northwestern Queensland, among the richest and most extensive in the world. Their significance was formally recognized by the Australian government when the fossil beds were incorporated into Lawn Hill National Park in 1992 and when UNESCO designated them a World Heritage Site in 1994. Among its important values, this fossil treasure provides a record of how Australia's ancient rainforests were transformed into a largely arid landscape in response to climate change over the last 15 million years.



PALEONTOLOGY AND CONSERVATION EFFORTS

However, *Australia's Lost World* is more than just a book about spectacular fossils. It is also about conservation biology and how paleontology can provide critical information for developing strategies for conserving our living biota. The authors make a strong case that the conservation status of living species can not be determined solely on information gathered over a few decades of modern field studies. As the authors write, (p.9) "Rarity can not be interpreted as anything other than rarity. To tell if a lineage is in the process of decline, stability, or

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rise, we must have an historical perspective—and not just that of the last few centuries." And for that reason this book should be of interest to the readers of *Park Science*.

The book provides several examples of how paleontology can be important for conservation issues. One of the more interesting ones involves the recent "plagues" of the crown-

of-thorns starfish (*Acanthaster planci*) on Australia's Great Barrier Reef. The recent blooms of this reef-eating starfish have been attributed to human interference, such as the over-collection of *Triton* snails, an important predator of this starfish. As a result, aggressive control programs were implemented to reduce the populations of *A. planci*, including having divers inject starfish with heavy metal solutions. However, this strategy was called into question when the fossil record of this starfish was more closely examined. Walbran et al. (1989) cored the Great Barrier Reef for just that data and found evidence for episodic blooms of this starfish going back more than 4,000 years, well before Europeans came to Australia. This has raised serious doubt as to whether or not these "plagues" are human induced. It also raised the intriguing question as to whether or not humans may have disrupted what may well be a normal, if cyclic, process, and that disruption might actually have had a detrimental effect on the very

reef systems those actions were designed to protect. Might not these starfish population explosions be the marine equivalent of a forest fire?

In some cases, paleontology can help identify both positive and negative impacts of what the authors call the "heavy hand of humanity." Using the Late Quaternary record of fossil vertebrate accumulations in caves, Alex Baynes (1990) determined that small to medium-sized Australian mammals show remarkable stability throughout the record preserved in caves. Changes in distribution patterns since the arrival of Europeans are many times greater than over the last 10,000 years. Here we can see that recent human activities have had a detrimental impact on species.

Flannery (1990), on the other hand, argues that the loss of many medium-sized arid and semi-arid Australian mammals is likely the result of a secondary chain of extinctions (a "trophic cascade") following the great extinction of Australia's megafauna some 20,000-40,000 years ago. That this cascade did not immediately follow the megafaunal extinction event is likely due to the Aboriginal use of fire, which maintained complex vegetation systems and thus delayed the trophic cascade. With the arrival of Europeans, and the subsequent loss of Aboriginal land management practices, extinctions accelerated to Late Pleistocene levels. One conclusion Flannery draws is that maintaining Aboriginal fire practices may well be important in preventing further extinctions.

IMPORTANCE OF THE PLEISTOCENE AND QUATERNARY RECORD

Australia's Lost World makes it clear that the Pleistocene and Quaternary fossil record of Australia has important information that needs to be incorporated into conservation plans for species and ecosystems. In fact, ecologists are now working as co-investigators on the Riversleigh projects because of their recognition of the potential for establishing long-term trends in Australian ecosystems.

The Pleistocene and Quaternary fossil record also contains valuable information for the United States (fig. 1, page 43). An understanding of this history is fundamental to the preservation of our current biota. Over the last 19,000 years in North America we have gone from the maximum southern spread of continental ice sheets to the present reduced glacier distribution. During this same time period the ecosystems shifted in



Figure 2. Discovered in Grand Canyon National Park, Arizona, this fossilized condor skull is evidence that the large, scavenging bird once lived in the area. This information was important in considering reintroduction of the species in the past decade. COPYRIGHT STEVE EMSLIE

response to the retreat of the ice sheet, the arrival of the first humans in North America, and a continent-wide megafaunal extinction. These tremendous changes are the crucible in which our modern biota was forged. Quaternary geologists and paleontologists have amassed a phenomenal amount of data for this time interval. Correlation of physical events, flora, and the fauna over the last 50,000 years of prehistory can be excellent, thanks to refined C^{14} dating techniques, which can yield dates with errors of only ± 50 years! Thus, fine-scale calibration of events and species distributions is possible. And while getting genetic material out of dinosaur bones is something best left to the movies, the wizards of molecular biology have successfully extracted DNA from more recent fossil bone. This allows us to trace the stability of or changes in population genetics, sometimes in still living species, over tens of thousands of years.

The fossil record also often includes species that are either still alive or are the immediate ancestors of living

"There has been little interdisciplinary overlap between Quaternary earth scientists and the modern conservation and restoration communities."

species (fig. 2). Even DNA is preserved! Here we have the record of very recent extinction and evolution, biotic crisis and biotic response. This is critical data for understanding how the present came to be and where it may head in the future. To ignore this record is unwise.

Surprisingly, in spite of all this branch of paleontology has to offer, there has been a lack of communication between Quaternary earth

than at present and that the fossil populations were genetically quite similar to extant populations. This information can be used to identify islands and areas where the reintroduction of the Laysan duck may be most successful.

The research of Wayne et al. (2000) is another example of how paleontological information can help conservation efforts. Studying the mitochondrial DNA of brown bears (*Ursus arctos*) preserved in the permafrost, these scientists have been unraveling the complex pattern of population genetics changes in this carnivore. Some 36,000 years ago the brown bear was much more diverse genetically, but by 15,000 years ago the level of genetic diversity had dropped to that of modern populations. The details of this work suggest that relying solely on the genetic diversity data of living brown bear populations could lead to erroneous conservation management decisions.

NEW ROLES FOR THE NPS IN PALEONTOLOGY?

What does all this mean for the National Park Service and the preservation of our living treasures? The Service has an extensive Inventory and Monitoring Program (I&M) under way—one that is monitoring both the living and nonliving components of our ecosystems. A predetermined core of basic data themes



is being gathered nationwide, while more specialized inventories, such as paleontology, are left to the responsibility of individual parks. Now I have heard some lamentations about fossils not being included in the I&M Program. In my view as a research paleontologist, fossils are generally not directly relevant to the problem the I&M Program is addressing—systematically gathering standardized information to establish a statement of the condition of the present-day ecosystems in relation to their unimpaired state. In particular, although we have learned much about dinosaurs from fossils, it is difficult to apply that knowledge directly to the problems of our present-day biota.

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But do not get me wrong. Fossils—even those that are not dinosaurs—are extremely important. They are, after all, the record of the history of life on our planet. Many national parks with fossils are international benchmarks for particular times in the past. Literally thousands of scientific papers have been published on fossils of the National Park System units and the list is continually growing. Our fossil resources need to be inventoried, monitored, studied, and protected because of our mission and their scientific and educational value, regardless of what they may or may not tell us about the future. Let us hope that the monies available through the Natural Resource Challenge for resource inventories will free up other sources (such as the Natural Resource Preservation Program) to fund systematic fossil inventories. Another possibility would be to develop Servicewide funding for paleontological inventories through the Natural Resource Program Center, where such inventories could be prioritized by resource and management needs.

It seems unlikely that the current NPS I&M Program can fund fossil surveys—even those with an emphasis on the Quaternary record. However, that should not prevent us from exploring how Pleistocene and Quaternary earth scientists might work with us to understand the time aspect of the resources we care for. Knudson (1999) and McDonald and Chure (2001) have

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recently made a similar plea. This cooperation will require partnerships with other land management agencies as well—the canvas on which the recent fossil history of North America is painted is larger than the lands administered by the

National Park Service. Maybe the Service, as the nation’s leading conservation agency, can help bring the paleontological and conservation professionals together. To do so may well reap great rewards. **P S**

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