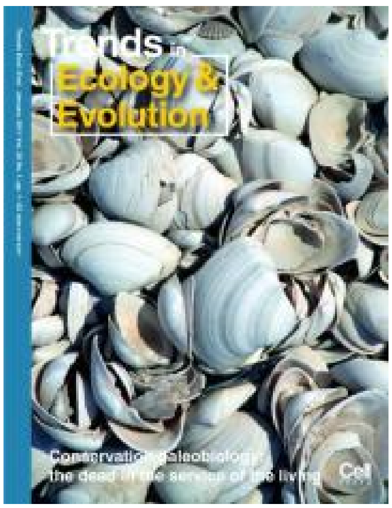
Putting the dead to work for conservation biology

January 19 2011



This is the cover image for *Trends in Ecology & Evolution*, published by Elsevier. Credit: Elsevier

scientists who use the fossil record to understand the evolutionary and ecological responses of present-day species to changes in their environment – are putting the dead to work.

A new review of the research in this emerging field provides examples of how the fossil record can help assess environmental impact, predict which species will be most vulnerable to environmental changes and provide guidelines for restoration.

The literature review by conservation paleobiologists Gregory P. Dietl of the Paleontological Research Institution and Cornell University and Karl W. Flessa of the University of Arizona is published in the January 2011 issue of the journal *Trends in Ecology and Evolution*. The National Science Foundation funded the research.

"Conservation paleobiologists apply the data and tools of paleontology to solving today's problems in biodiversity conservation," says Dietl, the director of collections at the Paleontological Research Institution.

The primary sources of data are "geohistorical," Dietl says, meaning the fossils, the geochemistry and the sediments of the geologic record.

"A conservation paleobiology perspective has the unique advantage of being able to identify phenomena beyond time scales of direct observation," he says.

Flessa says, "Such data are crucial for documenting the species we have already lost – such as the extinct birds of the Hawaiian islands -- and for developing more effective conservation policies in the face of an uncertain future."

Most conservation options are derived from modern-day observations alone, they state, and may not accurately predict the responses of species to the changing climates of the future.

Geohistorical records, the authors wrote, are therefore critical to identifying where—and how-- species survived long-ago periods of climate change

Ancient DNA, for example, has been used to show that the arctic fox (*Alopex lagopus*) was not able to move with shifting climates as its range contracted, eventually becoming extinct in Europe at the end of the

Pleistocene. However, the species persisted in regions of northeastern Siberia where the climate was still suitable for arctic foxes.

In another tale from the beyond, fossil evidence suggests that the birds of the Hawaiian Islands suffered large-scale extinction around the time of the arrival of the Polynesians. Studies comparing the ecological characteristics of bird species before and after this extinction reveals a strong bias against larger-bodied and flightless, ground-nesting species.

The pattern suggests that hunting by humans played a role in the extinction of the flightless species. By the 18th century, the time the first Europeans arrived in the islands; most large-bodied birds had already disappeared. European colonization of the islands led to a second wave of extinctions.

Those birds that survived had traits that helped them weather two onslaughts.

"Conservation research too rarely makes use of geohistorical data," says H. Richard Lane, program director in the National Science Foundation Division of Earth Sciences, which funds both Dietl's and Flessa's work. "Most such studies focus on short timescales ranging from years to decades. Looking back farther—much farther—in time may be crucial to comprehending events unfolding today."

In their review, Dietl and Flessa cite a study on the frequency of insect damage to fossil angiosperm leaves in the Bighorn Basin of Wyoming dating from before, during and after the Paleocene-Eocene Thermal Maximum (PETM, some 55.8 million years ago).

The PETM, scientists believe, is one of the best deep-time analogs for current global climate change questions because global average temperatures during this time period rose by ~ 9-14F˚ (5-8˚C) in less than 10,000 years.

Results from the insect research suggest that herbivory intensified during the PETM global warming episode.

"This finding provides insights into how the human-induced rise in atmospheric carbon dioxide is likely to affect insect-plant interactions in the long run," the authors wrote, "which is difficult to predict from short-term studies that have highly species-specific responses."

Time-averaged information, as is captured in the geologic record, says Lane, allows us to sort out natural changes from those induced by human activities.

The dead can help us even in remote places like the Galapagos Islands.

Scientists have used the fossil pollen and plant record there to shows that at least six non-native or "doubtfully native" species were present before the arrival of humans. This baseline information, says Dietl, "is crucial to a current conservation priority in the Galapagos: the removal of invasive species."

An important role of geohistorical data is to provide access to a wider range of past environmental conditions—alternative worlds of every imaginable circumstance.

The past may lead to better conservation practices that are crucial for life, not death, on Earth.

The dead, it turns out, do tell tales.

Provided by Paleontological Research Institution