

HIGHLIGHTED ARTICLES

Global climate change is transforming Kakadu National Park

Kakadu National Park, Australia's premier National Park, is being transformed by global climate change. Using advanced statistical analyses of historical sequences of aerial photography, Professor David Bowman, from the University of Tasmania, and his research team were able to show that woody plants have proliferated in the last 50 years within Kakadu's savanna landscape and have transformed sections of treeless floodplains into tracts of scrub.

Such marked increase in woody cover is surprising given concerns about the impact of hostile fire regimes on the Park and the legacy-effects of an irruption of feral water buffalo that was finally brought under control by a sustained control programme in the 1980s. However, the analysis is consistent with a number of previous related studies undertaken by Bowman's team.

The cause of the expansion is related to a trend of increased rainfall in northern Australia and possibly the 'fertilizer

effect' of increased atmospheric carbon dioxide, which favours growth of woody plants over that of tropical grasses.

The increase in woody vegetation has accelerated over the last 50 years because woody patch growth increases in a compound fashion. Such a non-linear pattern of woody increase has contributed to the erroneous belief that buffalo were the cause of the woody growth on the previously treeless floodplains – in fact the analysis showed that the buffalo control programme merely coincided with the dramatic expansion of woody plants.

The study is important as it shows the pervasive effects of global change on regional ecosystems. The expansion of woody plants is degrading wildlife habitat quality of Kakadu National Park's iconic wetlands, particularly for water-birds that need treeless conditions. The upside, however, is that the park is capturing carbon in the woody growth.



Kakadu National Park Floodplain.
Image credit: Caroline Lehmann

However, these effects may be transitory, as the IPCC's recent climate change assessment has identified the Kakadu freshwater floodplains as being at risk of destruction due to sea level rise during this century.

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Source paper: Bowman, D. M. J. S., Riley, J. E., Boggs, G. S., Lehmann, C. E. R. & Prior, L. D. (2008) Do feral buffalo (*Bubalus bubalis*) explain the increase of woody cover in savannas of Kakadu National Park, Australia? *Journal of Biogeography*, doi: 10.1111/j.1365-2699.2008.01934.x.

The peninsula effect may yet be seen as a red herring, but more light is needed

The peninsula effect is a classic biogeographical concept which predicts that the number of species declines from a peninsula's base to its tip. Two of three hypothesized causal mechanisms, the effects of geological history or habitat on species richness, can be controlled for by study design and/or statistical analysis. The third proposed mechanism (reduced colonization towards the peninsular tip) is attributed to peninsular geometry, and is less easily controlled. Dave Jenkins and Deb Rinne of the University of Central Florida asked two questions: (1) what is revealed by the 4-decade history of research on this concept; and (2) do microcrustaceans in Florida's isolated wetlands reveal a peninsula effect if the effects of history and habitat are controlled for?

Their literature review revealed mixed (49%) support for a peninsula effect, and found that most studies (86%) were not designed to control for alternative hypotheses or to quantitatively compare evidence regarding alternative hypotheses. Also, studies were strongly skewed to vertebrate animals (62% of studies); relatively little is known for other taxa. After controlling for history effects by study design, their own study of microcrustaceans in Florida wetlands revealed that habitat effects dominated (82.5%) of the pattern, and virtually no effect of peninsular geometry existed. This result is consistent with effective dispersal of microcrustaceans through geological time.

This study is important because it shows that much illumination is still needed on the long-standing concept of a peninsula effect, and demonstrates that careful study design and statistical analyses can shed needed light. Peninsula effect studies should: broaden in taxonomic focus; control for alternative causative hypotheses (geometry, habitat, or history) in study design; and quantitatively compare the effects of hypothesized mechanisms on peninsular diversity patterns.

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Source paper: Jenkins, D.G. & Rinne, D. (2008) Red herring or low illumination? The peninsula effect revisited. *Journal of Biogeography*, doi: 10.1111/j.1365-2699-2008-01943.x.

Uncovering genetic divergence and routes of gene exchange in the sand-obligate pallid kangaroo mouse, *Microdipodops pallidus*, from the Great Basin Desert

Kangaroo mice belong to the genus *Microdipodops* Merriam and are uncommon and rather bizarre-looking rodents, having enormous heads and large hind feet relative to their small (about 10 g) body size. The genus is endemic to the Great Basin of North America and includes two species: *M. pallidus* Merriam and *M. megacephalus* Merriam. The pallid kangaroo mouse, *M. pallidus*, is a sand-obligate desert rodent and this study examines its geographical distribution and formulates a phylogeographical hypothesis. This study also introduces a new analytical tool for testing orientation



A *Microdipodops pallidus* that was captured in Mineral County, Nevada
Image credit: P. M. Hafner

patterns in haplotype sharing for evidence of past episodes of gene flow.

The study examines mitochondrial DNA sequence data from early 100 individuals of *M. pallidus* sampled throughout its geographical range. The distribution of *M. pallidus* appears to be remarkably stable and is virtually unchanged from that determined three-quarters of a century ago. Unlike some other kinds of organism that show distributional adjustments in response to global climate change, there is no northward (or elevationally upward) distributional movement trend detected in *M. pallidus*.

Phylogenetic analyses show two principal clades, distributed as eastern and western units. The two clades are likely to represent morphologically cryptic species that diverged about 4 Ma. Results of this study (and a related study) now paint a picture of an endemic Great Basin taxon that diverged much earlier than thought previously and well before the creation of the extensive sandy environments during the Pleistocene and Holocene.

The directional analysis of phylogeographic patterns (DAPP analysis) used in this study is novel and may be useful in other studies. DAPP uses angular measurements of haplotype sharing between pairs of localities and circular statistical analyses to detect and quantify historical events pertaining to movement patterns and gene flow. DAPP analyses show significant, non-random angular patterns in both clades of *M. pallidus*. The phylogeographical patterns described here (both the eastern–western clades and the nonrandom directional patterns) may serve as a model for other sand-obligate members of the Great Basin Desert biota.

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Source paper: Hafner, J. C., Upham, N. S., Reddington, E. & Torres, C. W. (2008) Phylogeography of the pallid kangaroo mouse, *Microdipodops pallidus*: a sand-obligate endemic of the Great Basin, western North America. *Journal of Biogeography*, doi: 10.1111/j.1365-2699.2008.01942.x.

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