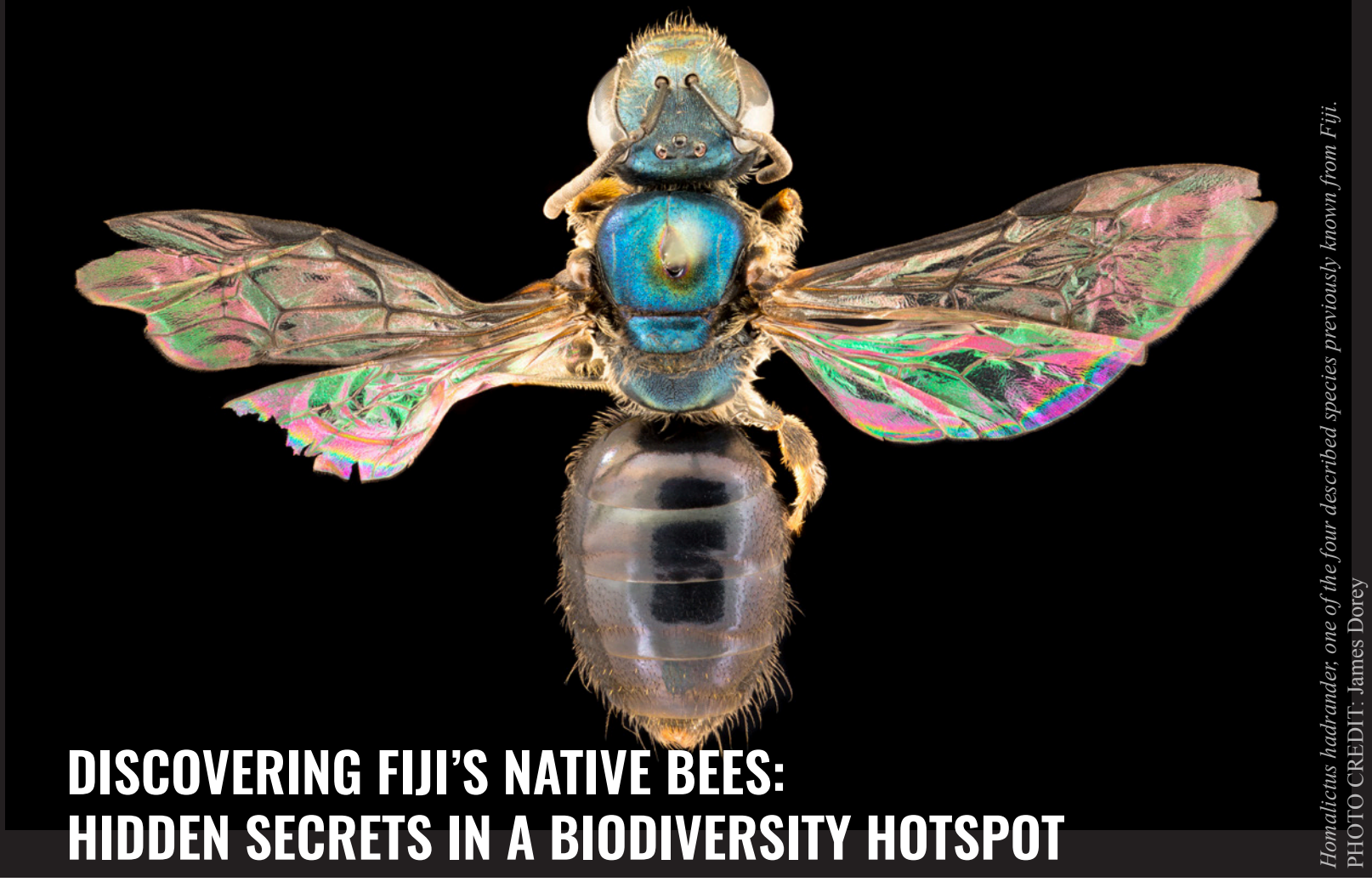

Homalictus hadrander, one of the four described species previously known from Fiji. PHOTO CREDIT: James Dorey

DISCOVERING FIJI'S NATIVE BEES: HIDDEN SECRETS IN A BIODIVERSITY HOTSPOT

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Researchers provide new insights into biodiversity using DNA barcoding in Fiji's topographically complex archipelago.

Fiji's entomological diversity has historically been considered depauperate. Recent widespread DNA barcoding efforts, however, from the South Australian Museum, Flinders University, and University of South Australia, along with a flurry of undergraduate, honours, and PhD students, have helped to uncover some of the hidden secrets of biodiversity within this topographically complex archipelago.

Since 2010, funding from the Australian & Pacific Science Foundation and Australian Commonwealth New Colombo Plan, along with support from students, has enabled fieldwork focused on collecting bees, wasps, and butterflies across all the major Fijian islands. Trekking up the tallest mountains, four-wheel driving across challenging terrain, and following the meandering rivers of inland Fiji has revealed that initial estimations of Fiji's entomological fauna have been severely underestimated.

DNA barcoding over 1,000 bee specimens has increased species richness estimates from 4 species (known since 1979) up to 26 endemic species in the genus *Homalictus*. Interestingly, 60% of these new species are only found above 800 m elevation which comprise a mere 2% of land area of Fiji, and they are often restricted to single mountain tops (Figure 1). From extensive DNA barcoding, mitochondrial

haplotype diversity was used to explore the level of intraspecific gene flow in the widespread species of the genus (Figure 2).

These results also indicate that gene flow is being restricted within highland localities of the most widespread *Homalictus* species. Dispersal from a species home range does not appear to be occurring in Fiji, which may be presenting a contemporary model of speciation that is predominantly influenced by past climatic fluctuations. There is an estimated crown age of 400 ka for the initial Fijian *Homalictus* colonisation, which would result in the genus being present for several glacial cycles.

During glacial maxima, cooler climates would be ubiquitous throughout Fiji, however during glacial minima and interglacial periods there is a distinction between cool highland and warm lowland climate. DNA barcoding results indicate that the largest diversification of this genus is concordant with the most recent glacial minima, as species that were freely dispersing during glacial maxima are forced to retreat into highland refugia.

Combined with the inferred haplotype networks, these results indicate that restriction due to low thermal tolerance of lowland climate is driving the extraordinary highland species richness in Fiji.

Further to the work on bees, we have also started barcoding Fiji's butterfly fauna, along with the first ever species of *Gasteruption*, a parasitoid wasp genus, found in Fiji. The species,*Gasteruption tomanivi* (Published in Zootaxa by PhD student Ben Parslow), was found at the peak of Fiji's highest mountain.

These discoveries have highlighted how little is known about the entomofauna of Fiji and how the use of DNA barcoding has helped to uncover Fiji's hidden secrets of biodiversity.

Online:

https://ibol.org/barcodebulletin/research/discovering-fijis-native-bees-hidden-secrets-of-biodiversity-in-a-tropical-hotspot/

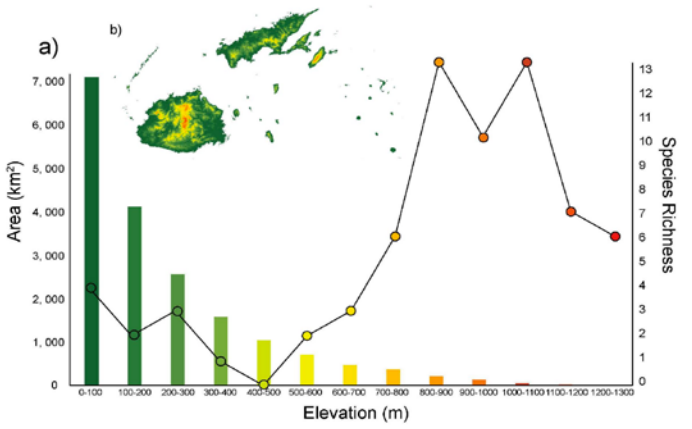

Figure 1: (a) The number of species (species richness) plotted against land area available at each elevational gradient. (b) Map of Fiji showing the land area available. Colours correspond to those used in (a).
IMAGE CREDIT: Cale Matthews

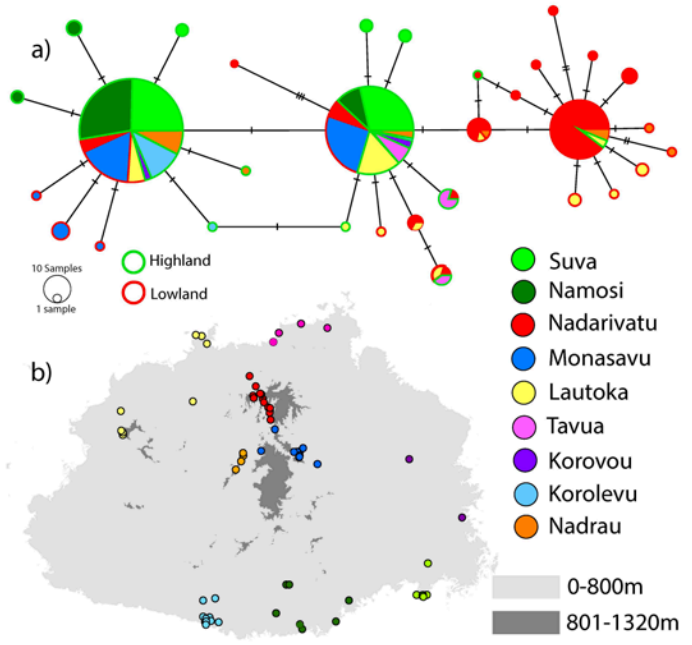

Figure 2: (a) Haplotype network of all sequenced Homalictus fijiensis (N=358) coloured by sampling locality. Hash marks represent nucleotide changes between each haplotype. Shared haplotypes represented by circles with multiple colours. Circle outline representing highland or lowland sampling. (b) Sampling map of H. fijiensis coloured by geographic sampling locality.
IMAGE CREDIT: Cale Matthews