Looking to the past with a view to the future

The following questions were asked during our live webinar with Jamie Wood but due to time restrictions, we were unable to answer these in the session.

Can traces of ancient DNAs be found in our current soils from our intensified farming systems?

Yes, quite likely, however I think any traces are likely to be extremely small (even by ancient DNA standards) and swamped by the large amount of modern DNA present in such sites. Oxygen and microbial activity, both of which would be characteristic of intensified farming systems, can degrade DNA rapidly. There are mechanisms where DNA molecules might persist longer in such environments (e.g. through chemically bonding to clay minerals) but the truth is we still really don't have a good understanding of how long DNA can persist in difference environments.

Do managers actually respond to your information? Do you have a favourite example of how your work resulted in an actual on-the-ground change that is being implemented?

This is something we are working towards, and presentations such as this are hopefully a way to increase awareness that such data do exist and could hopefully be useful. I think there is often a big-time lag between data being produced and it's uptake. The example I talked about involving Dactylanthus pollen in a kakapo coprolite has resulted in a next step being taken and has led to the initiation of a new trail camera study to look for and quantify bird pollination of the plant. Outside of our own work, there are other examples of where palaeobiology has been used in conservation decisions...the selection of mottled and Cook's petrel for translocation to Boundary Stream for example was based on the presence of bones from these species in nearby Te Waka cave

With vegetation cover, how do you distinguish between changes due to humans and introduced species rather than changing climate, hydrology, etc.

Usually we use multiple proxy types, each of which gives us slightly different information, and then interpret these together to see the complete picture. For example, the key indicator of local human activity is a large pulse of charcoal (far exceeding charcoal abundance obtained even in natural fires), which is then sustained over a long time period and is commonly associated with appearance of pollen types from bracken and grasses. Testate amoebae can provide information of palaeohydrology, as can pollen types of moisture indicator plants such as Potomageton (open

water), Typha/Cyperaceae (wet)...etc. Pollen assemblages can also provide information on temperature, through use of modern analogues and pollen transfer functions

The expected rise of temperatures and concurrent change of rainfall/snow intensity and patterns, and the potential elevation of treelines in the coming decades raises the question of 'best practice' ecological restoration based on extant climate regimes vs a projected near-term climate (100 years or so). I'm wondering if there is data on the period 110-120,000 years ago, which is a closer approximation of what our climate will be like.

Yes, although much less common than records from the past 18,000 years (current glacial) there are a number of sediment cores in New Zealand that extend back to this time earlier last interglacial period and which have had proxies such as pollen, chironomids (temperature proxy) and even beetle faunas, analysed. See for example: https://scholar.google.co.nz/scholar?hl=en&as_sdt=0%2C5&q=last+interglacial+pollen+new+zealand&btnG=

Really interesting talk! My question is whether the fossil record (as opposed to subfossils) could be useful for NZ conservation?

Yes, certainly there are a number of ways this might be possible. However, back beyond ~50,000 years New Zealand's terrestrial fossil record is very sparse and patchy. It is not really until you get back to the Early Miocene (~18 million years) that we have another substantial record of life on land (the St Bathans fossil sites in Central Otago). These older fossils can provide insights into which species or taxa might be really ancient endemics, and therefore could increase their conservation value. But in terms of relevance to modern day conservation there is little, mainly because the environment and climate was so substantially different to that which exists in New Zealand today (for example, at St Bathans there are bones of familiar NZ species such as tuatara, leiopelmatid frogs and acanthasitid wrens, yet there are also crocodiles and the climate at the time was more similar to that of northern Queensland).

Just wondering how on earth one identifies pollen grains in 1000 year old poo? Sounds like a hard job!

We have some very skilled technicians who are able to soak and soften the samples, then process with various chemicals to remove all the non-pollen elements so that we are left with pollen-rich microscope slides. Here at Manaaki Whenua in Lincoln we hold a comprehensive reference slide collection that includes pollen grains of pretty much every species of NZ plant, so we can compare and identify what we find in the old dung.

When you say that moa had very little effect on forest understory composition, how far back to those pollen records go, and is there any evidence for changes in forest composition following the deforestation associated with early human settlement?

For the moa study we purposefully focussed on sites with tall forest and which were unlikely to have been impacted directly by human settlement or anthropogenic activities. The cores were ~1000 - 2,000 years old at the bases. At most sites across NZ changes to forests during early settlement were

so severe that the forest seldom returned. In sediment cores this is reflected by loss of pollen from forest trees, contemporaneous spike in charcoal abundance, and replacement by spores of bracken and grass pollen (which favour disturbance and high fire frequency). Cases like that I described for the Poor Knights Island are actually pretty rare, there are few cases in pollen records where we see forest removed and then it comes back.