

General Research at the Australian Centre for Ancient DNA

The new Australian Centre for Ancient DNA is located in the Botanic Gardens, Adelaide. ACAD is a new research initiative aimed at studying evolution and environmental change through the analysis of preserved genetic records in animal, plant and environmental material. Our emphasis is on phylogenetic and population genetics studies of animal and human populations, testing and applying molecular clocks, and the general study of sequences distributed over time. The approach is to integrate ancient sequence information with modern data from archaeology, climate studies, and paleontology to analyze a variety of evolutionary and environmental processes - such as the impacts of climate change, human impact, and the validity of assumptions used in evolutionary studies. Key interests include the evolutionary relationships of extinct species, megafaunal extinctions, speciation processes, and human evolution. Research activities are based around PCR and cloning-based sequencing methods (requiring experience in molecular methods), or data analysis (involving a broad variety of bioinformatics and computational methods). Recent publications are available at www.adelaide.edu.au/acad

Specific Honours projects

Applying Ancient DNA techniques to Forensics

Recent methodological advances at ACAD have permitted some of the first in-depth analyses of how preserved DNA is damaged over time, and the likely impacts on the accuracy of retrieved genetic information. These new methods circumvent current limitations of the traditional PCR method, and allow the length and quality of DNA templates to be measured with great accuracy. This project will apply these methods to examine how burial and preservation under a variety of conditions alters DNA templates retrieved from hair, bone, teeth and tissue. The samples analysed will include animal specimens buried under controlled circumstances, South American mummies, and permafrost animal bones over 40,000 years old. The key issues to be examined will be the types and extent of DNA damage, and the rate at which templates degrade under different burial conditions.

The research will require good molecular biological skills, and an interest in forensics, ancient DNA, and DNA damage. Project supervisors will be Prof. Alan Cooper, Dr Jack Da Silva and Dr Jeremy Austin.

Examining the causes and implications of differences in long- and short-term evolutionary rates

Recent studies have shown that the apparent rate of molecular evolution changes according to the time period over which it is measured (Penny 2005, Ho et al. 2005). This curve explains the discrepancy between extremely fast rates observed in family pedigrees or within-individual viral diversity, and the rates calculated between species

or populations using fossil calibration points. This difference is thought to relate to the removal of many population-level mutations over time because they are slightly deleterious or via genetic drift, but has not been examined in detail.

This project will use existing Genbank sequences of mitochondria and viruses that have time series data to examine how rates at individual sites decline through time. Differences in this effect will be used to infer the amount of selection acting at sites, and related back to functional constraints. A variety of bioinformatics approaches will be examined, and the project will use computer-based population genetics and phylogenetic packages. Knowledge or interest in broad scale evolutionary processes and sequence analysis/computing would be valuable, and there is room for considerable individual input into the direction of the research such as the timescale of human evolution, domestication, and epidemiology/disease.

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