PROGRESS REPORT FOR AINGRA07048

**PROJECT TITLE**  
Reconstruction of floodplain palaeoenvironments by analysing carbon and nitrogen in sediments

**INVESTIGATOR(S)**  
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Geraldine Jacobsen  
Students  
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ANSTO Investigators  
Alan Williams  
Specialist Committee  
E

**SCIENTIFIC OBJECTIVES**

- To establish trophic state of the lower Murray floodplain of late Holocene period
- Track the sources of organic and enrichment
- To provide evidence of environmental change in Murray wetlands
- Determine the relationship between historical development with environmental changes
- Local and regional environments of the lower Murray region
- Provide baseline conditions of the floodplain for rehabilitation process.

**PROGRESS REPORT and RESEARCH OUTCOMES**

A 300 cm long sediment core was extracted from Mundic Creek wetland in January 2006. Stratigraphic analysis, diatom-inferred water quality and stable carbon and nitrogen isotope analysis were applied to reveal the changing nutrient status and sources. Radiometric (\(^{210}\)Pb, \(^{137}\)Cs and \(^{14}\)C AMS) dating techniques were used to establish the chronology of the sediment sequence. Stable carbon isotope analysis, carbon quantity and two \(^{14}\)C dates were conducted at ANSTO laboratory under this project. Additional two \(^{14}\)C dates were done at Waikato Laboratory, New Zealand. \(^{210}\)Pb and \(^{137}\)Cs dating were conducted at CSIRO Land and Water Systems Laboratory, Canberra. Nitrogen quantity was measured at Adelaide University facilities. It is impractical to describe the findings using only stable carbon isotope analysis, carbon quantity and two \(^{14}\)C dating. Therefore, data from other sources are also used in this report.

Organic nutrient cycles of the Murray floodplain system are very important to understand past and present environmental conditions. This research project clearly demonstrates how the trophic levels are influenced by natural and anthropogenic factors. The data also predicts the future direction of the trophic status in the lower Murray wetlands, and therefore the outcomes of this project can be used for improved wetland management. To further refine our understanding, additional analyses such as, particle size distribution, diatom analyses, aquatic plant macrofossil analysis, pollen analysis, additional radiometric (\(^{210}\)Pb, \(^{137}\)Cs and \(^{14}\)C AMS) dating techniques, major and minor elements and sedimentary pigments analysis were also conducted. In terms of multi-proxy analysis, Mundic Creek is the most intensely studied system in Australia, and as well as providing data about organic nutrient cycles, also has the potential to inform about wetting / drying phases (and hence, drought frequency) over the past 2700 years.
\(^{14}\text{C} \) age/depth data shows that sedimentation rate in Mundic wetland was 0.8 mm per year during the late Holocene period. Whereas \(^{210}\text{Pb} \) and \(^{137}\text{Cs} \) dating indicates that the more recent sedimentation rate has increased dramatically, up to 15 mm/yr, particularly after non-indigenous settlement. This increase is due to catchment disturbance, land use practice changes, agricultural developments and other anthropogenic activities in the region.

Sources of organic input have changed in the lower Murray floodplain, principally by an increase in \( \text{C}_3 \) terrestrial plant detritus input after non-indigenous arrival (Fig. 2). The sources of organic matter were predominantly freshwater algae origin during late Holocene period (~3000 yrs) (Fig. 2).

The study shows a significant variation of stable carbon isotope in the past (Fig. 3). The trophic system of the pre-European wetland was quite stable over time and was driven by in-lake algal activity. Altered microbial contribution to the biomass has resulted in variable \( \delta^{13}\text{C} \) since European settlement. After European settlement terrestrial inputs became greater relative to algal production. Hence, human activity has significantly changed the trophic state that is recorded in the biomass composition.

The drivers of changed trophic state and accelerated sedimentation rates since European settlement can be associated with the changes to land and water use (grazing, river regulation), water quality (eutrophication, increased turbidity) and wetland condition (infilling). Assessment of the causes of these outlined shifts is being refined with diatom, pollen, ancient pigments, particle size distribution and major/minor elements of sediment data.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
Depth (cm) & Year & Calibrated Age BP \\
\hline
160 & 620 & 616 \\
260 & 1790 & 1800 \\
\hline
\end{tabular}
\caption{Calibrated \(^{14}\text{C} \) age}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
AINSE Code & Sample Name & Depth, cm & \( \delta^{13}\text{C} \) & \%C \\
\hline
SI0399 & Mundic 0 & 0 & -28.7 & 3.4 \\
SI0400 & Mundic 4 & 4 & -27.7 & 2.4 \\
SI0401 & Mundic 8 & 8 & -27.5 & 2.3 \\
SI0402 & Mundic 12 & 12 & -27.1 & 3.1 \\
SI0403 & Mundic 16 & 16 & -26.6 & 2.4 \\
SI0404 & Mundic 20 & 20 & -26.3 & 2.3 \\
SI0405 & Mundic 24 & 24 & -26.8 & 2.5 \\
SI0406 & Mundic 28 & 28 & -26.3 & 2.6 \\
SI0407 & Mundic 32 & 32 & -25.8 & 3.2 \\
SI0408 & Mundic 36 & 36 & -25.3 & 3.1 \\
SI0409 & Mundic 40 & 40 & -25.8 & 2.3 \\
SI0410 & Mundic 44 & 44 & -26.2 & 1.8 \\
SI0411 & Mundic 48 & 48 & -25.9 & 1.7 \\
SI0412 & Mundic 52 & 52 & -24.9 & 2.0 \\
SI0413 & Mundic 56 & 56 & -24.8 & 2.0 \\
SI0414 & Mundic 60 & 60 & -24.3 & 2.2 \\
SI0415 & Mundic 64 & 64 & -24.6 & 2.1 \\
SI0416 & Mundic 68 & 68 & -24.5 & 1.6 \\
SI0417 & Mundic 72 & 72 & -25 & 0.9 \\
SI0418 & Mundic 76.80 & 76 & -24.4 & 1.1 \\
SI0419 & Mundic 80.80 & 80 & -25.6 & 1.7 \\
\hline
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\caption{\( \delta^{13}\text{C} \) and \% of carbon}
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Fig 1: $^{14}$C age depth relationship of Mundic wetland.
Fig 2: $\delta^{13}C$ and C/N value of major sources in sediments. Data shows that organic material in Mundic wetland came from aquatic plants before European settlement. Later this source shifted to be dominated by terrestrial organic sources.

Fig 3: $\delta^{13}C$ data shows a stable trophic state during the late Holocene period compared to the recent decades.

Signature of Investigator preparing the report for
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