

Blending Indigenous science with molecular techniques using Environmental DNA

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Key Points

- Traditional Owner collaboration using eDNA.
- Management of a culturally significant species *Anguilla australis*.
- eDNA as a tool for positive engagement and collaboration.

Abstract

Environmental DNA (eDNA) technology can be a culturally and ecologically sensitive method for surveying biodiversity, with a simple sampling methodology that can simultaneously cover multiple groups of organisms, whilst not requiring specific expertise like some scientific survey methods. This provides a significant and meaningful opportunity for natural resource managers, including Traditional Owners to lead innovative ecological surveys and decision-making on Country. eDNA has the opportunity to be a mechanism for Traditional Owners across Australia to gather knowledge and connect with Country, whilst gaining additional survey skills that can be utilised by industry to generate further opportunities.

Here we present how a Traditional Owner group is currently supporting researchers by using eDNA to undertake biodiversity surveys. We provide an example of how eDNA surveys and complementary research are currently being undertaken by Indigenous Rangers to explore short finned eel (*Anguilla australis*) distribution throughout an UNESCO world heritage site on Gunditjmarra Country. Outcomes will help address key management questions, by providing valuable information to help protect and restore critical habitats for sustaining the populations of the culturally significant species, whilst demonstrating meaningful Traditional Owner, industry and research engagement. Additionally, the success of the study has highlighted eDNA's wider potential and has prompted further monitoring through long term multi-species biodiversity assessments.

Keywords

Environmental DNA, Indigenous Science, Freshwater Ecology, Biodiversity Surveys.

Introduction

Background

Environmental DNA (eDNA) technologies have gained widespread adoption for wildlife monitoring of terrestrial and aquatic habitats in the last decade, allowing for a quick, sensitive, less invasive, and cost-effective method of species presence via the detection of genetic material that is shed into its local environment (Rees et al., 2014; Barnes et al, 2016; Shaw et al, 2016). The survey tool has been used to answer a range of monitoring questions through single species detections commonly for threatened species and pest incursions, as well as multispecies detections for characterising broader biodiversity (Coleman et al., 2023). With the increased use of eDNA for ecological research its application has now become commonly incorporated for industry practitioners and citizen scientists. In particular, eDNA's ability to offer quick and cost-effective species assessments across large geographical areas has shown promise as a tool for Traditional Owner groups to help survey significant landscapes on Country. Here we provide some examples of how eDNA is being

applied throughout the Budj Bim cultural landscape on Gunditjmara Country in South-Western, Victoria by Gunditjmara caring for country through Gunditj Mirring Traditional Owner Aboriginal Corporation (GMTOAC) with Deakin University.

Kooyang monitoring

Anguilla australis (short-finned eel) is a culturally important species that is distributed throughout South-Eastern Australia, with the species cultural value particularly evident in the UNESCO world heritage Budj Bim landscape. Here the species known as ‘*Kooyang*’ is a cultural totem for Gunditjmara and has formed the basis of an ancient aquaculture system dating back almost 7000 years (McNiven et al, 2012) (Figure 1). For Gunditjmara, *Kooyang* is an important symbol which has linked people and place for thousands of years, providing connection to past generations, Country and culture (Rose et al, 2016). Eel fisheries in this region and across the species range are following global trends, with climate change and commercial harvest precipitating population declines and reductions in the recruitment of juveniles in recent years (Jacoby et. al, 2015). This has raised concerns for the conservation of this culturally important species and highlights the need for an improved understanding of eel ecology and biology to inform future management.

GMTOAC have been using eDNA alongside cultural knowledge to further the understanding of *Kooyang* habitat use and spatial ecology within the Budj Bim landscape, by testing water samples for eel eDNA signatures to determine presence/absence (Figure 2). Findings from this study address research and management priorities for GMTOAC and provide a valuable spatial management layers for identifying key protection and restoration objectives for critical habitats sustaining eel populations within the Budj Bim cultural landscape, as well as demonstrating the efficacy of eDNA.



Figure 1. Drone imagery showing parts of the aquaculture system within the Budj Bim landscape (captured by GMTOAC). a) Showing a stone weir and holding pond site b) Showing channels made to deviate water through the catchment.

Engagement perspectives shared by GMTOAC

The use of eDNA surveys in this project has provided a great opportunity for meaningful engagement between research institutes, industry and Traditional Owners. Collaboration with Traditional Owner groups can provide enhanced research and management outcomes through knowledge sharing and collaboration. *Kooyang* monitoring within the Budj Bim landscape has demonstrated a significant example of positive engagement. Through reflection on this current project, GMTOAC identified some key learnings on collaboration to help support genuine Traditional Owner engagement into the future.

Developing a collaborative project is a partnership of learning, a two-way knowledge sharing process was essential to forming meaningful connections throughout this project. This was facilitated through the partnership combining two separate knowledge holders, research institutes offered an understanding of eDNA and molecular tools, whilst GMTOAC held a deep connection and knowledge of Country and *Kooyang*. This

combination offered the opportunity to teach and learn, providing the best possible foundation for successful research and management. It was important that the transfer of knowledge between project partners went both ways.

Forming positive collaboration can take time and was crucial to understand and accommodate for that throughout the project. It was important to be mindful that when Traditional Owners share culture on Country that these are incredibly significant and spiritual places. When developing the research questions, it was essential that all partners helped to drive the process, as the custodians will ultimately be applying the research outcomes and are the key knowledge holders of species and place. eDNA sample sites were guided by the understanding of where *Kooyang* resided in the catchment as traditional knowledge of Country informed this understanding. Unfortunately, at times GMTOAC have had requests for data collection with no communication of results or study outcomes, this in the past has led to a feeling of being exploited. This project collaboration aimed to ensure long-term knowledge sharing, occurring across all stages of the project from design, data collection, data processing, data sovereignty and authorship, the project ensured that there was involvement across all components.

A learning from this project was to allow more opportunities for Traditional Owner community members to become involved in the project, to ensure that there is exposure to all types of work occurring on Gunditjmarra Country. This could be achieved in future by informing partners of current collaborations or by presenting research to communities regularly, allowing anyone that is interested to seek out ways to become involved. It would be important that community engagement happens regularly as relying on a single workshop/seminar can limit the potential pool of people to attend.

Additionally, AIATSIS (Australian Institute of Aboriginal and Torres Strait Islander Studies) provide engagement policies that are crucial when collaborating with traditional owners (AIATSIS, 2020). These policies prioritise respect for the cultural protocols and knowledge systems of Indigenous communities, fostering trust and mutual understanding. By incorporating AIATSIS guidelines, researchers and stakeholders ensure that their work is conducted ethically and responsibly, acknowledging the rights of traditional owners to control and protect their cultural heritage. This adherence promotes meaningful partnerships that are essential for producing accurate and respectful representations of Indigenous cultures and histories. Ultimately, by upholding AIATSIS engagement policies through this project, individuals and organisations can help contribute to preserving Indigenous knowledge and supporting community-driven initiatives for cultural preservation and empowerment.



Figure 2. Gunditj Mirring Traditional Owner Aboriginal Corporation (GMTOAC) eDNA sampling within the Budj Bim landscape.

Conclusions

eDNA is shown here to be an effective tool for Traditional Owners to undertake biodiversity surveys. Key benefits of this monitoring tool that enhance collaboration between scientific researchers and Traditional Owner groups are it's quick, cost effective and easy application allowing for surveys across large areas,

providing opportunities for Traditional Owner groups to gain knowledge and be on Country. The tool has helped form collaborative research relationships that have resulted in creating data needed for freshwater species management in the region (eDNA results from the project to be published at its completion). This study hopes that the experience of this collaboration to build ecological knowledge on a culturally significant species for Traditional Owners can help guide other effective Indigenous research collaborations.

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