Charles Sturt University

Foundation Trust

Reading the River:

Turning environmental DNA detection into preventative conservation action for the Bellinger River Snapping Turtle

Rural and regional communities embody a spirit of resilience, resourcefulness and innovation that sustains our economy, culture and heritage. With your support today, we will unleash this spirit for the benefit of all.

Charles Sturt University - Case for Support

Advancement Office
02 6338 4211

Charles Sturt University Foundation Trust

Reading the River:

Turning environmental DNA detection into preventative conservation action for the Bellinger River Snapping Turtle

A silent threat is moving through our rivers, long before we see its impact.

Freshwater turtle conservation in the Bellinger and Kalang Rivers is shifting from reacting to crisis, to preventing it.

By analysing environmental DNA, microscopic traces that organisms leave behind in water, emerging threats such as pathogens, invasive species and ecosystem stress can be detected before visible decline occurs. River water becomes a continuous source of insight, revealing risk while there is still time to respond.

More than monitoring, this approach enables earlier, targeted conservation action. It draws on the proven power of biosurveillance and wastewater monitoring as early warning systems, capable of identifying disease trends before outbreaks become apparent.

Developed by Charles Sturt University and strengthened through citizen science, the system operates as a low-cost, scalable network that expands monitoring reach while building community stewardship.

The outcome is a fundamental shift in conservation: protecting vulnerable turtle populations not after decline begins, but before it takes hold.

The Bellinger River Snapping Turtle (*Myuchelys georgesi*)

Once abundant along the Bellinger River, the Bellinger River snapping turtle (*Myuchelys georgesi*) now teeters on the edge of extinction. A sudden and devastating viral outbreak in 2015 almost erased the species in a matter of weeks. Today, silent threats remain: fast-moving diseases, invasive turtles and genetic hybridisation pressures, all operating beneath the surface of the water but there is hope.

The Bellinger River snapping turtle is now listed as Critically Endangered freshwater turtle found nowhere else on Earth. It lives exclusively in the clear, fast-flowing waters of the Bellinger River catchment in northern New South Wales, making it one of Australia's most geographically restricted vertebrates.

This long-lived turtle plays an important role in river ecosystems, contributing to nutrient cycling and the overall health of freshwater habitats. Its survival is closely tied to clean water, stable river flows and intact riverbanks—conditions that also support many other native species.

Because the entire species exists in a single river system, it is especially vulnerable to environmental change and disease outbreaks. Protecting the Bellinger River turtle means safeguarding the health of the river itself, ensuring that threats are proactively detected early and managed carefully.

Charles Sturt University Foundation Trust

Why they need help

In 2015, the Bellinger River snapping turtle experienced a sudden and severe disease outbreak that caused rapid population declines within its only natural habitat. The outbreak highlighted how vulnerable a species confined to a single river system can be when threats move undetected through the environment. While emergency conservation actions helped stabilise the population, the event underscored the importance of early detection and ongoing river-wide monitoring to protect the turtle's long-term future.

The citizen-science eDNA Biosurveillance Platform

This platform is a scalable environmental monitoring system that uses citizen-science collected water samples to detect:

- Known and emerging turtle pathogens, including Bellinger River Virus and related disease agents in river water,
- Invasive turtle species at low abundance before establishment in the Kalang River
- Broader ecosystem health signals, reflecting changes in river biodviersity and ecological condition

Rather than focusing on diseased individuals, this approach captures the health status of the river system itself, providing a real-time window into disease risk and ecological change. This is one of the most promising conservation technologies available for Australian freshwater turtles, shifting the focus to preventing a crisis rather than responding after one has occured. This system translates environmental DNA detection in river water into actionable conservation intelligence, enabling earlier, targeted management responses before disease impacts become visible in wildlife populations

What the platform will deliver

- Early detection of known and emerging **turtle pathogens** before outbreaks escalate
- Rapid identification of **invasive turtles**, enabling timely management response
- System-wide monitoring of **river ecosystem health using eDNA signatures**
- Decision-support data for **conservation breeding, translocation, and release programs**, including pathogen-risk screening of release environments

Research Team:

Dr Jessica Tout-Lyon, project lead

Dr Jessica Tout-Lyon is an molecular and microbial ecologist and lecturer at Charles Sturt University, with a strong track record in applying innovative science to real-world conservation challenges. Her research focuses on using environmental DNA (eDNA) to understand what is happening beneath the surface of aquatic ecosystems, revealing risks that traditional monitoring cannot see.

Distinguished Professor Muhammed Shiddiky,

Prof Shiddiky is a global leader in the fields of analytical chemistry, sensor technology and nanobiotechnology, specialising in developing biosensing methods and portable diagnostics devices. The primary focus of his research is to advance the understanding of microfluidics, nanobiotechnology, electroanalytical chemistry, and surface chemistry-based phenomenon and processes for the development of new biosensing methods and point-of-care/on-site devices for biomedical, agriculture and environmental applications.

Dr Fatema Farhana,

Dr Fatema Zerin Farhana is currently a Research Fellow at the Shiddiky Laboratory within the Rural Health Research Institute at Charles Sturt University (CSU), Australia. She achieved her PhD and MPhil degrees in functional nanomaterials from Bangladesh University of Engineering and Technology (BUET). She was honored with the highly prestigious Bangabandhu Science and Technology Fellowship from the Ministry of Science and Technology, Bangladesh Government. Her research focuses on the development of functionalized nanoparticles based diagnostic platforms for various biomedical applications.

Dr Kiran Shrestha

Dr Kiran Shrestha is currently a Research Fellow at the Shiddiky Laboratory within the Rural Health Research Institute at Charles Sturt University, Orange, Australia. He achieved his PhD degree in Biophysics from Sungkyunkwan University, South Korea. His research focuses on the development of fabrication-friendly handheld molecular diagnostic devices.

Omar Bin Manjur

Omar Hamza Bin Manjur is a PhD student with a strong academic foundation in Biochemistry and Molecular Biology, having completed both his Bachelor's and Master's degrees from the University of Dhaka. With over 3.5 years of research experience, he has held scientific positions at renowned scientific institutions in Bangladesh, including BRiCM, BCSIR, and ideSHi. His research interests lie in liquid biopsy, single-cell biomarkers, and advanced molecular diagnostics. Currently, his work focuses on developing cost-effective and accessible point-of-care (POC) biomarker-based detection tests for pathogenic microorganisms that contribute significantly to the global burden of disease.

Project Investment Options

This program offers a tiered investment pathway to develop a citizen science–enabled environmental DNA (eDNA) biosurveillance system for detecting turtle pathogens, including Bellinger River virus, across the Bellinger and Kalang Rivers.

Option 1: Full Impact Program (3 years)

Total investment: $560,910

- Postdoctoral researcher (3 years, full-time, Level B): $171,970 per annum (incl. 17% super and on-costs)
- Operational costs: $45,000

Investment focus: End-to-end development, field deployment, and scale-up of an integrated eDNA biosurveillance platform

This program will deliver:

- A validated molecular detection assay for turtle pathogens, including Bellinger River virus
- A portable, point-of-collection eDNA biosurveillance platform for citizen scientists
- Field validation across the Bellinger River catchment, including environmental sampling workflows
- A scalable biosurveillance framework adaptable to other freshwater wildlife disease systems
- Translation and engagement with community, conservation, and scientific stakeholders

Outcome: A fully operational, field-ready biosurveillance system that shifts pathogen detection from retrospective laboratory confirmation to real-time, distributed environmental monitoring.

Option 2: Full-scale pilot project (12–18 months)

Total investment: $186,970

- **Postdoctoral researcher (1 year, full-time, Level B): $171,970 (incl. super and on-costs)**
- **Operational costs: $15,000**

Investment focus: Proof-of-concept and prototype establishment

This project will deliver:

- Design and development of eDNA assays for detection of turtle pathogens in river water
- Laboratory validation of assay sensitivity and specificity
- Development and integration of an early-stage prototype workflow for field sampling and detection
- Engagement with community stakeholders and conservation partners to test feasibility of citizen science deployment

Outcome: A validated proof-of-concept demonstrating reliable environmental detection of target turtle pathogens in river water, establishing the foundation for full-scale deployment.

Option 3: Proof of concept monitoring pilot (12 months)

Total investment: $35,000

- Lead researcher salary support (part-time, Level C): $15,000
- Operational costs: $10,000

Investment focus: Environmental surveillance, sampling network establishment, and distribution mapping

This project will deliver:

- Longitudinal collection, preservation, and analysis of citizen scientist–collected eDNA river water samples over 12 months
- Spatial and temporal mapping of the presence, distribution, and relative abundance of Bellinger River virus and other potential turtle pathogens across the Bellinger and Kalang Rivers
- Ongoing community engagement and reporting of surveillance findings

Outcome: Establishes a proof of concept for citizen science–enabled environmental surveillance, generating the first longitudinal dataset on pathogen presence and distribution in the Bellinger and Kalang Rivers while strengthening the monitoring network that underpins future scaling and innovation.

For the public good and to safeguard native species

Beyond its immediate conservation application, this platform represents a scalable model for national biosurveillance infrastructure. By enabling earlier detection and response, the platform shifts conservation from reactive outbreak management to preventative intervention.

This initiative delivers a shared environmental biosurveillance system that functions as national public-good infrastructure for freshwater ecosystem health. By integrating citizen science with environmental DNA (eDNA) detection, it enables low-cost, scalable monitoring of pathogens, invasive species, and ecological change across river systems in near real time.

While initially focused on the critically endangered Bellinger River snapping turtle (*Myuchelys georgesi*), the platform is designed as a transferable framework applicable to other Australian freshwater species of conservation concern, including threatened fish and amphibian populations.

This creates a reusable biosurveillance infrastructure that supports earlier detection of emerging threats, improves conservation decision-making, and strengthens Australia's capacity to protect biodiversity before irreversible decline occurs.

Charles Sturt University Foundation Trust

Why Now?

Prevention is better than cure

Environmental DNA (eDNA) science has reached a genuine turning point. Once an emerging research tool, it is now a proven field-ready approach capable of detecting early signals of disease, invasive species incursions and ecosystem change that traditional monitoring targeting diseased individuals miss.

This matters because early detection in water is not an end point in itself; it is an operational trigger for evidence-based management action. Detecting pathogen DNA in river water provides advance indication that disease agents are present in the environment, before widespread infection is observed in wildlife populations. This enables targeted, timely responses such as intensified surveillance, movement restrictions, biosecurity measures, and prioritisation of at-risk populations for monitoring or intervention.

At present, wildlife disease management is largely reactive, relying on visible morbidity or mortality events before action is taken. By that stage, population-level impacts are often already underway and management options are limited.

The Bellinger River snapping turtle (*Myuchelys georgesi*) remains critically endangered following the 2015 outbreak, with ongoing exposure to pathogen, invasive species, and environmental pressures. This creates a narrow but important window in which environmental surveillance can directly inform preventative management rather than post-outbreak response and can change conservation outcomes.

Crucially, the scientific capability, community interest, and sampling framwork are now in place. What is missing is an integrated, scalable eDNA biosurveillance system that converts environmental detection into routine, decision-ready information for conservation action.

This convergence of readiness and risk makes immediate investment strategically important. It enables a shift from reactive wildlife disease response, where action follows decline, to preventative conservation, where environmental detection informs earlier and more targeted intervention, improving the likelihood of avoiding population-level loss.

Ultimately, this will give this Critically Endangered turtle its strongest chance of long-term recovery and safeguarding an irreplaceable part of Australia's natural heritage while improve the long-term outlook for Australia's freshwater biodiversity and strengthen protection before further decline occurs.

To learn how you can be involved, contact Craig Trethowen, ctrethowen@csu.edu.au to discuss opportunities to support this work.

Charles Sturt University Foundation Trust

For the public good

Charles Sturt University has a proud heritage and an ethos of nurturing students to become holistic, far-sighted citizens who help their communities grow and flourish. The name of the University honours the noted explorer, soldier and public servant Charles Sturt. In the tradition of exploration, learning, inquiry and discovery as embodied in the life and work of Charles Sturt, the University has as our motto -for the public good.

Scholarships and financial support play an important role by supporting the aspirations of our students and our communities for participation in higher education and to give them the ability to achieve their educational and research goals.

Charles Sturt University Foundation Trust

About Charles Sturt University

A combination of state-of-the-art facilities, innovative use of technology and teaching expertise has resulted in an outstanding graduate employment rate. Charles Sturt thrives by challenging traditional approaches to education through the use of flexible learning systems, which are constantly being developed to improve course delivery. This strategy has put Charles Sturt University at the forefront of communication technology, a position that allows students from isolated regions to access quality resources and education.

Charles Sturt takes pride in regional and rural Australia. The University has a network of campuses in Albury-Wodonga, Bathurst, Dubbo, Wagga Wagga, Orange and Port Macquarie along with smaller specialist campuses throughout Australia. Charles Sturt works together with industry to offer every student a great start to their career. The knowledge and industry experience that students gain at Charles Sturt through its close collaboration with business and the professions is keenly sought by employers -a fact reflected in our high graduate employment rate.

The Charles Sturt University Foundation Trust (CSUFT)

The Charles Sturt University Foundation Trust is a non-profit entity sitting within Charles Sturt University. The Trust has endorsement as an Income Tax Exempt Charity and carries Deductible Gift Recipient status. All donations above $2.00 to the Charles Sturt University Foundation Trust are tax deductible.

The Charles Sturt University Foundation Trust has been providing support for the University and its students since 1984.