

Samford Ecological Research Facility

2017-2018 Annual Report

About the Samford Ecological Research Facility

The Samford Ecological Research Facility (SERF) is a 51-hectare property in the Samford Valley. The property was generously bequeathed to QUT by renowned Queensland entomologist Dr Elizabeth Nesta (Pat) Marks AO. Seventy per cent covered with vegetation, SERF provides refuge to native plants and animals under increasing pressure from urbanisation. The vegetation is protected and classified under the *Vegetation Management Act 1999*.

SERF is managed by QUT's Institute for Future Environments (IFE). It is used for research, teaching and learning programs involving many subjects including soil, water and air quality, groundwater systems, microbiology, plant biology, invertebrate and vertebrate biology, ecology, ecosystem monitoring, population management, vegetation and soil mapping, geographic information systems, sustainable building techniques and experimental design.

The SERF Management Team includes **Juan Cooper** (IFE Distributed Sites and Infrastructure Manager), **Sach Jayasinghe** (IFE Director, Research Infrastructure), **Peter Grace** (IFE Theme Leader – Managing for Resilient Landscapes, Professor of Global Change) and **Michelle Gane** (IFE Knowledge to Innovation Broker).

This report covers SERF activities from July 2017 to June 2018.



Research

SERF is a unique facility that gives QUT researchers and students opportunities to investigate the climate, environment, soil, water, vegetation and wildlife of a peri-urban ecosystem. Since 2012, SERF has been classified as a South-East Queensland Peri-urban Grassland Supersite as a facility of the Terrestrial Ecosystems Research Network (TERN) and part of the Australian Supersite Network. Operating under the National Collaborative Research Infrastructure Strategy (NCRIS), TERN is a nationwide Australian Government program of systematic, automated ecosystem monitoring.

Ecological Monitoring



Many long-term ecological monitoring research studies take place at SERF. The environmental monitoring and data collection using the SERF OzFlux station has continued (**Professor Peter Grace, Dr David Rowlings** and **Dr Clemens Scheer**). The TERN OzFlux station is part of a network of micrometeorological flux stations located at various sites within Australia and New Zealand where exchanges of carbon dioxide, water vapour and energy between terrestrial ecosystem and atmosphere are measured continuously over long periods.

Other ecological field studies on the SERF site include activities associated with automated greenhouse gas measurement (**Dr David Rowlings** and **Dr Clemens Scheer**), soil-atmosphere exchange and nitrogen cycling in Australian forests (**Dr David Rowlings** and **Dr Clemens Scheer**), water quality, flow and nutrient dynamics (**Dr Martin Labadz** and **Dr David Rowlings**) and soil moisture chemistry research (**Dr David Rowlings**).

Unmanned Aerial Vehicles and Autonomous Vehicles

The SERF property has been in high demand for non-autonomous Remotely Piloted Aircraft System (RPAS) operations. IFE's **Research Engineering Facility** has continued to trial the use of unmanned aerial vehicles (UAVs or drones) fitted with different payloads near and/or above the tree line at SERF for teaching and research projects. SERF is proving to be a geographically convenient location for the purposes of thermal, high-resolution RGB, hyperspectral and multi-spectral camera systems integration flights and testing ahead of deployment into the field for research projects.



Unmanned vehicle operations were also carried out on the ground at SERF with **PhD student Leo Stanislas** collecting data with a robot around the Barracks. This project is using a Clearpath Husky mobile robotic platform fitted with multiple sensors and remotely controlled on the various tracks at SERF to test the robustness of the experimental perception system to avoid dangerous obstacles such as rocks and logs while navigating on walking tracks. The different types of terrains (tall grass, dusty fields, and rough terrain) at SERF represent a very realistic outdoor environment.

Flora and Fauna Studies



The unique and stable environmental conditions on the SERF property make it possible to observe and measure changes in flora, fauna and biophysical processes over time, providing important insights into environmental variability and the significant impact of urban development.

A long-term vegetation survey program conducted within a one-hectare plot by **Research Assistant David Tucker** forms part of the ongoing monitoring of the South-East Queensland Peri-urban Grassland Supersite. This program measures several structural vegetation attributes of flora, samples for genetic and carbon isotope analysis, and collects species as herbarium specimens. Seasonal changes in canopy cover along parallel transects have also been monitored.

A second major long-term study is the bird species survey conducted by **Masters student Dez Wells** who has been visually and acoustically surveying within a two-hectare ecological sample area at SERF.

The major focus of the research involves testing sound attenuation in relation to vegetation type to determine the abundance of bird species. The considerable amount of research data collected by solar acoustic monitoring instruments installed on-site, is then uploaded to the TERN Supersite data portal periodically throughout the year.

The conservation biology of the threatened native olive species (genus *Notelaea*) in Southern Queensland is the focus of a new research project established at SERF in 2018 by **PhD student Chapa Manawaduge**. The study aims to compare the life history and ecological traits of the two rare and two common *Notelaea* species, and involves a reproductive biological study and a population genetic study of the two threatened *Notelaea* species. Field observations of the biological traits and some pollination experiments will be used in the study. As part of this study, phylogenetic analyses will also be conducted focusing on the systematics ambiguities of the genus *Notelaea*. Data will be mainly obtained through field work (within southern Queensland and including SERF), seed germination experiments and herbarium sampling.

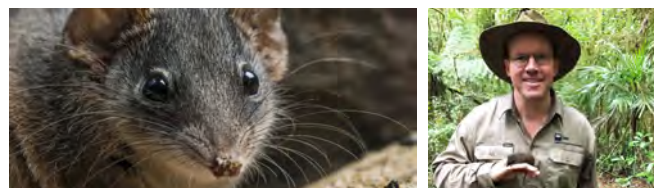
Insect Studies



Myrtle rust is a serious fungal disease, caused by *Uredo rangellii* or *Puccinia psidii*, which belongs to the eucalyptus or guava rust complex of rust fungi. It requires a living host and affects plants in the *Myrtaceae* family. Producing large numbers of spores, myrtle rust is easily spread by wind, human activity and animals. The disease is native to South America, but it is now present in many areas of Queensland including the Samford Valley. While the fungus and the spores are believed to be non-toxic to wildlife and humans, it is likely to make foliage and fruits less palatable as well as affect their nutritional value.

In 2017, **Associate Professor Carrie Hauxwell** established a project using SERF's insect enclosure screen houses to investigate the potential role of bees as vectors of myrtle rust principally through the movement of *Apis mellifera* bees and beehives. The aim of this project is to develop protocols for detecting the presence of myrtle rust spores on bees and in beehives, and use the protocol to determine the risk of commercial beehives in the spread of myrtle rust.

Animal Studies



The ageing Australian population is growing and frailty and ageing-related diseases, such as heart disease, Alzheimer's disease and many cancers, pose significant social and economic challenges. Increasing our understanding of ageing may lead to economic and health benefits by uncovering new intervention strategies. In 2017, **Dr Andrew Baker** began a research project at SERF to use the antechinus, a unique Australian marsupial, as a model of rapid ageing in order to understand this fundamental biological process by studying its genome.

Antechinus are an Australian marsupial (pouch-bearing) mammal species that have a unique life cycle. Males are very short lived, breeding for only one short season (1-3 weeks) before ageing rapidly and quickly dying off. Antechinus may provide a better model for human ageing than laboratory mice. For example, while old laboratory mice and rats never have natural changes in their brains comparable to Alzheimer's disease in humans, ageing antechinus do show similar brain pathology and may represent better models of human ageing. Antechinus are, therefore, a rare and useful model of ageing in mammals.

Australian Acoustic Observatory

The SERF site is now part of the Australian Acoustic Observatory (A2O), a continental-scale acoustic sensor network, recording environmental acoustics for a five-year period across multiple Australian ecosystems. A2O is a QUT-led research collaboration between ecologists, biologists and computer scientists which will see an observatory established to analyse Australia's fragile and mega-diverse environment through sounds detected and recorded by sensors installed in more than 400 locations around the country.

The project at SERF is funded by an ARC Linkage Infrastructure, Equipment and Facilities grant of \$900,000 awarded to **Professor Paul Roe**. Eight acoustic recorders will be located at SERF and supported by **Research Assistant David Tucker**. Four recorders will be a permanent part of A2O, with two located in wet habitat and two located in dry habitat. One acoustic recorder will be permanently located within close proximity to the Barracks for display and promotional purposes. Two acoustic recorders will be temporary and mobile, and used for testing solar panels and acoustic recorder performance under different canopy covers.

Education

SERF continues to play a significant role in QUT's educational programs and provides many opportunities for undergraduate students to conduct experiments in the field and gain practical research experience.

Environmental Sciences



Ecosystem change and the impact of human factors on the environment are important issues in today's society. The SERF property's unique and stable mix of native forest and pasture provides an ideal location for students majoring in environmental sciences to assess these issues. First year undergraduate students studying unit course **EVB102 Ecosystems and the Environment** investigated the relationship between species diversity and habitat type by surveying the composition of the ant population in forest, edge and pasture habitats.

Remote sensing science and technologies can be applied to acquire information about an object or phenomenon without making physical contact. Students studying unit course **EVB221 Remote Sensing and the Environment** explored the use of aerial sensor technologies to collect biophysical properties for a range of vegetation at the SERF site through the operation of a small UAV to collect imagery of a constrained one-hectare field plot. Students then correlated this aerial data with ground vegetation data collected using traditional transect quadrant methods.



The study of soil science is fundamental to environmental soil analysis and management, to understanding the importance of soil for ecosystem function in a changing environment, and to the critical role of soils in the context of climate change. Students enrolled in course unit **EVB312 Soil and the Environment** study the links between biological, ecological and geological systems to better understand the complexity of environmental systems in general. Using the established soil pits at SERF, students investigated the total profile depth, horizon depths, texture, colour, pH, electrical conductivity and structure to better understand the concept behind soil descriptions, identifying soil horizons and the major properties of each soil horizon.

Biological Sciences



The diverse range of flora and fauna found at SERF provides the perfect opportunity for students majoring in the biological sciences to examine wildlife and plants in an environmentally natural system. A practical understanding of field survey methods is very important in the study of a site's flora, fauna and ecosystem ecology. Students in unit course **BVB202 Experimental Design and Quantitative Methods** visited SERF to apply various field methods including construction of line transects and quadrants to assist in data collection.

SERF supports a rich habitat for fauna such as the Yellow Footed Antechinus, Dunnart, Brush Tailed Possum and Mountain Brush Tailed Possum, Bush Rat, Melomys, Long Nosed Bandicoot, Northern Brown Bandicoot, reptiles, amphibians and a myriad of bird species.

Engineering

Students in unit course **BVB214 Vertebrate Life** conducted a field vertebrate study looking for mammals and reptiles in leaf litter, pitfall traps and Elliot traps as part of an examination of Australian animal diversity and evolution. SERF's remnant vegetation communities also support an abundant insect population. Students studying unit course **BVB223 Insect Life** gained a greater understanding of field entomology by applying various insect collection techniques to examine a variety of specimens from the site in insect traps, and collect insects for their insect collections.

The forested areas of SERF have an abundance of birdlife, and students studying **BVB311 Conservation Biology** used these forested areas to apply field skills in biodiversity monitoring. The theory and practice of conservation biology is essential for maintaining viable populations of rare, threatened or endangered species and for maintaining essential ecosystem processes. The field trip included a study using artificial bird nests and eggs to estimate the risk of bird nest predation at edge and interior forest locations.

Students enrolled in unit course **BVB321 Invasion Ecology** completed a field trip at SERF focused on invasive plant species. During the visit, the students were required to estimate the density of invasive species (plants, animal signs) and compare environmental parameters between weed invaded (lantana) and weed controlled vegetation by collecting information on light transmittance, soil moisture and canopy cover.

Sustainable urban development requires careful consideration of the potential impact on a site's flora and fauna. Students in unit course **EGB274 Environmentally Sustainable Design** visited SERF to visually survey and observe plants to incorporate the natural resource values of the site into their proposal to minimise any development's impact on the site's flora and fauna. This environmental assessment required students to observe vegetation and soil, take photographs and record physical data throughout the SERF site. Ecological vegetation condition surveys at SERF were also conducted by students enrolled in unit course **EGB380 Environmental Law and Assessment**. Students undertook a mock development assessment to understand more about the adverse consequences of human activity and government development planning regulations.

UAVs with on-board decision making for precision target detection, using computer-vision, are becoming a main research focus. Students enrolled in unit course **EGH450 Advanced Unmanned Aircraft Systems** undertook a field project to further develop their knowledge, skills and application of aerospace concepts, building on aircraft systems and flight and unmanned aircraft systems. The aim of this project is to develop an autonomous multi-rotor vehicle capable of detecting targets and testing the air surrounding the targets for temperature, humidity and CO₂. Students carried out a detailed design analysis to design, build and flight test their multi-rotor UAV system.



Outreach

SERF is not just a facility for QUT academics and students. Every year, it is visited by a broad range of people, including researchers from other institutions, Federal, State and local government representatives and other groups.

Visitors

Professor Peter Grace hosted a group of Environmental Science students from Michigan State University on **13 July 2017**. The group were particularly interested in the wide range of research activities carried out at SERF.

Juan Cooper hosted a visit and lunch at the Barracks for 20 members of the Marks family on **10 September 2017**. Family member **Jane Hassell** later reported that the family had an enjoyable day at SERF. "It brought back many memories for the older family members and our newest ones thought it a wonderful place. We enjoyed hearing about the other environmental places and are happy this one is so close to home."

Marcus Yates hosted a group of 23 Masters of Architecture students and three staff members from the University of Queensland for a site visit and tour on **23 March 2018**. The students were enrolled in the Advanced Architectural Design: Landscapes and Architecture course which requires them to understand, map and work closely with the ecology of a site.

The students were particularly interested in biodiversity of the Samford region, learning about the flora, fauna, soil and water ecology, as well as electronic processes to gather and monitor information, particularly the adaptive and acoustic sensing processes.

Juan Cooper hosted another visit and lunch at the Barracks for 25 members of the Marks family on **28 April 2018**. The event was organised by family members **Stephen Tonge** and **Margaret Ward** as a small family reunion to commemorate Pat Marks' 100th birthday.

Dr Susan Fuller and **Professor Paul Roe** hosted a visit to SERF for a group of 100 delegates from the Ecoacoustics Congress 2018 on **28 June 2018**. The congress was co-hosted by QUT from 24-28 June 2018. As part of the activities, delegates were taken on a field excursion involving birdwatching at Andy Williams Park in Cedar Creek, followed by a tour and bush walk at SERF and a BBQ breakfast at the Barracks.



Local Community Information Session 2017

Each year, IFE hosts a local community information session at SERF to enable Samford residents and the broader community to learn more about the research and teaching activities at the property. The session includes an overview of the university's activities at SERF, information about exciting research projects and developments and an opportunity for community members to ask questions.

In 2017, the information session was held on **9 November** and featured presentations from QUT researchers and media coverage of activities conducted at SERF.

Site Technician Marcus Yates provided an update on research and teaching activities and infrastructure maintenance and upgrades made at SERF during the year. He also displayed some great images of fauna captured on remote sensor wildlife cameras.

Dr Fernando Vanegas Alvarez presented on the variety of UAV-based research carried out by QUT including operations on the SERF site. He brought in a UAV for display, which provided the local community members with the opportunity to get up close to a typical research platform.

Past **PhD student Aead (Ayad) Muhmed** gave a presentation on his research project conducted in the insect enclosures at SERF. This study looked at the ecological and behavioural aspects of the parasitoid wasp *Diachsmimorpha kraussii* whose larval stage attacks the Queensland fruit fly. The study investigated its host foraging behaviour and the role of learning in the host location experience.

Media clips from several television shows were shown, including an item on Myrtle Rust shown on ABC TV News, 4 June 2016 with **Dr Grant Hamilton** and an item on acoustic sensors featuring **Research Assistant David Tucker** at SERF, shown on the Scope children's science show, 10 September 2016, on Network Ten.



Artwork Donation



A special event at the local community information session held on **9 November 2017** was the historical donation of a piece of artwork by Anne Clark OAM and Peter Clarke.

The Clarkes presented SERF with a framed photograph of a watercolour of the Marks family residence and Barracks painted by artist Marian Clarke about 1921. It was one of two watercolour paintings by the artist inspired from her only visit to Brisbane in 1921.

ABOUT THE ARTIST:

Marian Clarke was born in England in 1853, one of 13 children, and arrived in Sydney in 1884 to assist at Normanhurst, a school run by her sister Ellen. In July 1885 she founded Abbotsleigh School for girls, and with great determination brought to the curriculum many subjects hitherto unavailable for girls, such as science and mathematics.

She retired from the school in 1913 and embarked on a painting career, studying under distinguished masters. In 1924 she had the first of several of her pictures accepted by the Salon de la Société des Artistes Français, Paris.



Operations and Management

Governance and Staff



During 2017, the IFE welcomed the appointment of **Dr Rebekah (Bek) Christensen** to the role of Senior Policy & Projects Officer (Research Infrastructure) within the IFE Directorate. Bek commenced in the role on 16 October. Bek has worked across university, state government and NGO contexts and comes to the role with significant experience in research infrastructure. Most recently, Bek has worked as part of the leadership team at the UQ-hosted TERN Office (the Terrestrial Ecosystem Research Network – the national observatory for Australian ecosystems), an NCRIS-funded national research infrastructure facility.

Natural Habitat

The IFE has for several years carried out a woody perennial environmental weed eradication program. Much of this work was conducted by **Charlie Sparks** and **Prue Macfarlane** under the close supervision of **Marcus Yates**.

The aim of this program is to reduce the density of pest weed species, giving native species the opportunity to flourish and minimise the spread of pest weeds from the SERF property and into neighbouring land. This has been very successful and has resulted in much invigorated forested areas at SERF.

In the early 1900s vegetation was extensively cleared to the creek bank for small crops and grazing, and the land harvested for high quality timber. These activities are now an issue for land erosion and invasive weeds.

In 2016, we identified an area bordering the Samford Creek that had been left untouched for many years resulting in a severe pest weed infestation. **Site Technician Marcus Yates** successfully surveyed the site for native species and cleared the area of all pest weeds. As custodians of one of the last significant areas of remnant vegetation in the Samford region, it is QUT's responsibility to attempt to regenerate this area.



After significant planning and engagement with QUT Facilities Management Sustainability, a reforestation project was undertaken on Friday 11 May 2018. Ten eager undergraduate students from varying disciplines within QUT provided assistance in planting 335 native trees, plants and shrubs to a pocket of land in the south-west corner of the property adjacent to Samford Creek. Three Macadamia trees, propagated from seed from an existing specimen on the SERF property, were also planted. This species is listed as endangered.

By introducing native plant species once present in large populations along the banks of Samford Creek, QUT will be contributing to the biodiversity of the region, not only adjoining the SERF property but also further downstream.

Infrastructure



The Barracks roof has three solar array systems provided by the Kaneka Corporation which were installed in 2010 as photovoltaic test systems. The systems include 10 Kaneka Hybrid Panels, 15 Kaneka Thin Film Amorphous Panels and five Kyocera Monocrystalline Panels. During the period April to June 2018, the SERF site consumed 1534kWh of electricity. Over the same period, the total electricity generated by the three solar arrays was 234kWh which is equivalent to a GHG emission saving of 184kg of CO₂. While the numbers are small, this is an example of IFE's commitment to sustainability in its management of the SERF site. The Barracks also has both toilets plumbed to a Biolytix 'ecosystem in a tank' system. This doesn't need costly mechanical aerators to run, resulting in significant energy savings and negligible methane emissions which have global warming potentials of more than 30 times CO₂.



Invigorated Forest Areas at SERF

BEFORE: Severe overgrowth of weeds in one of the forest areas at SERF



DURING: Undergraduate students removing weeds and replanting area with native species



AFTER: Weeds successfully removed and reforestation aims achieved





2018-2019 Goals

Over the next 12 months, several key goals have been identified to further improve the operations and amenity of the SERF property, including:

- Review the strengths and benefits of SERF
- Plan future QUT research and teaching directions
- Investigate links with existing and potential external partners
- Improve ongoing communication across the SERF user community



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