



ASSAY

A NEWSLETTER ABOUT ACID SULFATE SOILS

No 38. September 2004

Acid sulfate soils in the Garden of Eden?

Here in Australia we are familiar with wetlands being drained for agricultural production or urban development. However as the National Coastal Acid Sulfate Soil Committee (NatCASS) heard at its May meeting, swamps have been drained to achieve entirely different outcomes in Iraq. The marshlands of southern Iraq, believed to be the location of the biblical Garden of Eden were once famous for their biodiversity and cultural richness. Touted as one of the largest wetlands in the world, the area was home to millions of birds and was an important stop for billions more migrating between Siberia and Africa. The southern marshlands were also home to the Marsh Arabs whose lifestyle of fishing and farming remained relatively unchanged for the past 5,000 years.

Shortly after the Persian Gulf war ended in 1991, Saddam Hussein's government angered by Marsh Arab participation in the southern uprising against his rule, launched an assault on the southern wetlands and the nearly 300,000 Marsh Arabs who called the region home. The assault included a sophisticated campaign of water diversion and drainage along with the systematic burning of villages and surrounding marsh vegetation. Under Hussein's regime the marshlands were drained and burnt, until in 2003 roughly 93% of the original 20,000 square kilometre area had been all but destroyed.

With their elaborate reed houses burnt and their lifestyle irreversibly changed many of the Marsh Arabs moved to Iran or became internally displaced within Iraq. With the collapse of the former regime the Marsh Arabs are now

returning to the area and (similar to many places in Australia) are opening floodgates and breaching embankments to bring water back into the marshlands.

An international effort has been formed to assist local residents restore some of the marshlands important functions to aid their re-settlement. Part of the 25 person international team is Australian scientist and NatCASS member Dr Rob Fitzpatrick who despite security problems completed a 10-day trip through the marshes in April this year (*cont. over page*).



Rob Fitzpatrick enjoying a canoe ride through Iraq's southern marshlands during his ten-day trip early this year.

Amongst the range of issues that need to be addressed during the restoration of the marshes, Rob has identified a wide range of new anthropogenic, saline, sodic, gypsic and calcic soil types, which variously contained high quantities of sulfidic material (pyrite and monosulfides), sulfate-rich salt efflorescences and burnt fragments of soil. Rob returned to Australia with 50kg of soil and water samples, and has characterised the soil and water processes occurring in the now degraded marshlands. These results will assist in identifying the limitations to re-establishing agricultural production and re-settlement in the drained wetland system.

Watch out for the next edition of ECOS, CSIRO's popular magazine, which will include an in-depth feature article about Rob's adventures in Iraq, based on his report: Fitzpatrick, R.W. (2004). Changes in soil and water characteristics of some natural, drained and re-flooded soils in the Mesopotamian marshlands: Implications for land management planning. CSIRO Land and Water, Client Report 2004. <http://www.publish.csiro.au/ecos>

NSW UPDATE

North Coast Floodgate Project exceeds target

In early 2001 large fish kills occurred in the Richmond, Clarence and Macleay catchments after heavy rain and flooding. The fish kills were largely attributed to de-oxygenated water from rotting floodplain vegetation and the mobilisation of mono-sulfidic black ooze in floodplain drainage systems. As the flood water receded and drainage systems started to discharge, dissolved oxygen levels crashed to near zero in the main river channel killing thousands of fish.

With the community wanting solutions, one proposal was to increase the number of floodgated drainage systems being opened in non-flood periods, known as active floodgate management. NSW Fisheries then developed the

North Coast Floodgate Project, with the target of opening a further 50 floodgated drainage systems across the three catchments, building significantly upon the past initiatives of local councils and landowners.

Funded by the NSW Government's Environmental Trust and with the support of local government, this two year project has now exceeded its original target of 50 floodgates. A total of 54 floodgates are now being actively managed across the three catchments. The project has assisted local councils and landowners by providing technical support and much needed funding. This has allowed the necessary winches and automatic tidal devices to be fitted that allow floodgates to be actively managed.

By doing so the project has improved water quality. Monitoring has shown when floodgates were open acidity decreased, water temperature remained more stable and dissolved oxygen values increased. Other benefits of floodgate management have been shown to include greater fish passage and provision of habitat, better aquatic weed control and more drought tolerant pasture production.



Floodplain Project Manager for the Clarence Valley Council, Jeremy Challacombe being filmed as part of a documentary on floodgate management.

The project will also produce a documentary video in association with FILMSTREAM. Titled *'the floodgate story - the good, the bad and the ugly'* the documentary will be told through the eyes of farmers, fishermen and floodplain managers.

For further information contact Simon Walsh, Conservation Management Officer for the Department of Primary Industries on (02) 6686 2018 or simon.walsh@fisheries.nsw.gov.au

Snapshot of Success - Clarence Floodplain

The Clarence River located in northern NSW, is on a scale of its own. The Clarence is the largest coastal river in NSW and its estuary supports the largest commercial fishery in the state. Its large coastal floodplain has been intensively drained and supports beef and sugar cane industries, economically important to the local region. The floodplain also contains extensive deposits of high risk acid sulfate soils.

Catchment snapshot	
Clarence river catchment	22,400 km ²
Floodplain area	2,620 km ²
High risk acid sulfate soils	530 km ²
Publicly owned flood mitigation drains	268 km
Publicly owned floodgated systems	186
Recognised acid sulfate soil 'hotspots'	4

In the mid 1990's, local stakeholders met to discuss their increasing concerns of the impact floodplain drainage was having on river health and water quality. Stakeholders felt that the former Clarence River County Council (now Clarence Valley Council Floodplain Services) was in the best position to address these issues, and to coordinate the management of floodgates and drains. This proposal met with unanimous support and in 1997 the Clarence Floodplain Project was established.

At the time the concept was unique; a project based in the local council who managed the

public floodgates and drains, with a steering committee consisting of representatives from all major stakeholders including industry and landowners. The project funded a dedicated officer who liaised with landowners and where consensus could be reached, developed on-ground demonstration projects. This model has since been adopted in many other coastal catchments in NSW.

In 1999 the Healthy Rivers Commission completed an Independent Inquiry into the Clarence River system. A recommendation of the Inquiry was to pilot a 'partnership agreement' for managing coastal floodplains based on the Clarence Floodplain experience. The partnership, which will be trialed in the Clarence will see all stakeholders involved with the management of the floodplain and estuary sign a formal partnership. The partnership will outline the common objectives and goals of all stakeholder groups in relation to river health and water quality. Such a document will be used to pursue funding and will demonstrate strong community commitment to sustainability.

Now in its seventh year of operation the Clarence Floodplain Project has resulted in at least 80 km of waterways being re-opened to tidal influence, improving water quality both in the drains and the Clarence River. Thirty-eight creek and drain management plans have been developed and over 100 landholders are now actively managing their drainage systems. In addition 5 drained wetlands areas have been re-inundated and restored.

The success of the project has been largely due to the support of landholders and their willingness to help develop and commit to management plans. The Clarence Floodplain Project has also greatly benefited from funding obtained from the Clarence Valley Council Floodplain Services, the Natural Heritage Trust, NSW Fisheries, the NSW Environmental Trust, Acid Sulfate Soil Program and from Land and Water Australia and Fisheries Research and Development Corporations.

For more information contact Jeremy Challacombe, Floodplain Project Manager for the Clarence Valley Council on (02) 6642 3277 or jeremy.challacombe@clarence.nsw.gov.au

Weed Alert - Hymenachne

With increased interest in wet pasture systems as a means of managing acid sulfate soils, authorities are keen to alert landowners of weed issues associated with the practice. One potential problem is the introduction of Hymenachne, a semi-aquatic grass as a ponded pasture species.

Hymenachne was first imported to Australia in the 1970's as fodder in ponded pasture systems of central Queensland. The perennial, robust grass that can grow up to 2.5 metres tall has escaped cultivation to invade tropical wetlands and waterways of northern Australia.

Hymenachne is currently listed as a Weed of National Significance. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential to spread and economic and environmental impacts. Hymenachne can reproduce from both seed and broken stem fragments. These can be transported downstream during annual flooding, and can also be spread in mud attached to animals.

Local agronomists report that Hymenachne was tried on the North Coast of NSW sometime before its pest status was known. In most cases planting of the grass failed because of extreme soil acidity or drought, however there are a number of areas where Hymenachne has survived and thrived.



Rod Ensbey inspecting an infestation of Hymenachne in the Richmond Catchment.

Hymenachne is currently being considered for noxious weed declaration. If declared, Hymenachne can not be promoted, sold or planted and current infestations will need to be contained, reduced in size and eventually removed. A fact sheet on Hymenachne can be downloaded from www.weeds.crc.org.au/documents/wmg_hymenachne.pdf For further information contact Rod Ensbey, Regional Weeds Co-ordinator for the Department of Primary Industries on (02) 6640 1648.

Qld UPDATE

Laboratory Methods Guidelines complete

After an extensive review period, version 2.1 of the Acid Sulfate Soils Laboratory Methods Guidelines dealing with analysis of dried samples is now available. Coordinated by the Queensland Acid Sulfate Soil Investigation Team (QASSIT) the guidelines are the result of a collaborative effort between NSW and Queensland Acid Sulfate Soil Management Advisory Committees with the support of NatCASS.

The expectation, at least in Queensland, is that all acid sulfate soil investigations will use the laboratory methods contained in the completed Guidelines, and not those superseded in *Guidelines for Sampling in Lowland Acid Sulfate Soils in Queensland* (1998) and *Laboratory Methods Guidelines chapter* in the *NSW Acid Sulfate Soil Manual* (1998).

The Acid Sulfate Soils Laboratory Methods Guidelines can be downloaded from <http://www.nrme.qld.gov.au/land/ass> and take the link to 'Publications and Products'. Hardcopies of the 132 page document are available for a fee of \$30, or \$15 for a cd.

For further information or copies of the Guidelines contact Kristie Watling, Land Resource Officer for the Department of Natural Resources, Mine and Energy on (07) 3896 9229 or kristie.watling@nrm.qld.gov.au

Sample Exchange Program

Occurring concurrently with the finalisation of the Acid Sulfate Soils Laboratory Methods Guidelines is the development of Australian Standards for the analysis of acid sulfate soils. The Standards Committee (EV-009-02-01) has been examining the dry sample methods outlined in the Acid Sulfate Soils Laboratory Methods Guidelines and it is likely that most methods will become Australian Standards.

However before this process is finalised a sample exchange program has to occur between laboratories and any other interested parties that analyse acid sulfate soils. The exchange program will be run by QASSIT with the assistance of state agencies and consultants who have provided some of the soil samples for testing. It is anticipated that the exchange program will commence in October.

If you are interested in participating in the program please contact Patricia Carreto at Standards Australia
patricia.carreto@standards.org.au

Rain and temperature likely cause of red spot outbreak in Noosa River

Natural changes in water quality due to high rainfall and temperature fluctuations in March and April this year are the likely cause of the recent outbreak of red spot fish disease in the Noosa River. Department of Primary Industries and Fisheries Regional Manager Dr Ross Quinn said that commercial operators and recreational anglers had reported various fish species, mostly yellow-finned bream, with red ulcer-like lesions this year. Environmental Protection Agency Regional Director Damien Brown said analysis of water quality monitoring data highlighted a drop in salinity and in pH levels in March, coinciding with high rainfall. EPA investigations have found no evidence of any discharges of pollution or acidic water from any specific site or activity during that time-frame. Mr Brown explained further, under low-rainfall conditions, rain water is mixed with sea water coming in from the ocean, resulting in brackish water with a mid-range pH. When there is a lot

of fresh water in the river, the sea water is unable to restore the salinity and buffering ability, and pH levels may also drop, making the water more acidic. In this case, fresh water persisted in the river for some time, replenished by subsequent rainfall events. The water temperature also dropped sharply about this time - another of the stresses that can lead to red spot disease.

Acid sulfate soil a factor in *Lyngbya* vulnerability mapping

Lyngbya majuscula is a naturally occurring, toxic algae found in many tropical and subtropical marine areas around Australia. The algae grows attached to seagrass, sea weed, and rocks in clumps or mats of fine, dark cotton wool-like strands 10 to 30cm long. Under the right conditions the algae can grow at very rapid rates to produce large, extensive blooms. A variety of adverse environmental, economic and human health impacts are associated with these blooms of *Lyngbya* which can cause severe irritation to skin on contact.

Since the early 1990's, Moreton Bay has been the location of many blooms with their size and frequency appearing to be on the increase.



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Email: brian.williams@alsenviro.com

Monitoring suggests that inputs of iron, phosphorus and organics appear to be common factors at bloom sites along the Queensland coast.

A current project will map potential land-based sources of the factors in order to identify areas vulnerable to Lyngbya blooms. The project will collate existing data and maps, including those on acid sulfate soils. With disturbed acid sulfate soils being a potential source of mobilised iron, this information together with information on groundwater and proximity to streams flowing to the coast will be an important component in determining vulnerability.

For further information contact Shane Pointon from the Department of Natural Resources, Mines and Energy on (07) 3896 9352 or shane.pointon@nrm.qld.gov.au

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WA UPDATE

Acid Sulfate Soil Framework Launched

In June, Western Australian Minister for the Environment, Dr Judy Edwards launched the state's framework for managing acid sulfate soils. The framework, based on the National Strategy, is set to improve understanding and management of the issue.

Acid sulfate soils have been identified in various parts of the State, including the Peel-Harvey inlet region, at Yunderup in the South-West, across parts of the Swan-Canning catchment, and at Stirling. During the launch of the framework Dr Edwards identified that "this is an environmental problem that requires the participation of community and environmental groups, local government and several State Government agencies and I am pleased with the way things have progressed".

To download a copy of the framework log on to http://www.environ.wa.gov.au/downloads/2687_ASS_ManagementFramework.pdf

Major Workshop

Western Australian stakeholders have been treated to a major three-day workshop during September. Organised by the Centre of Excellence for Sustainable Mine Lakes with the support of the Department of Environment, the workshop was held at the Mandurah Performing Arts Centre on the 1st to the 3rd of September.

The workshop brought together overseas, interstate and WA-based experts, along with representative from communities, industry, government, education and research agencies to share knowledge and experiences in acid sulfate soil management. Key speakers included Dr Rob Fitzpatrick from CSIRO, well recognised for his experience in acid sulfate soils, and Dr Jes Sammut from University of NSW, an expert on aquatic impacts of acid sulfate soils. They were joined by Dr Jannie Maree of South Africa who specialises in the treatment of acid mine drainage.

The workshop also contained a session where delegates identified what they thought were major acid sulfate soil issues and research gaps. This information will be used to identify future research directions in Western Australia.

For further information on the workshop or the proceedings contact
rosdesmier@westnet.com.au

SA UPDATE

Using vegetation to map acid sulfate soils

Mangrove and saltmarsh communities have been used in a recent South Australian project, mapping the State's coastal acid sulfate soils. The Natural Heritage Trust funded project utilised existing state wide mapping of mangrove and saltmarsh communities

previously undertaken by the Department for Environment and Heritage, where approximately 103,000 hectares of habitat were mapped.

In order to use the vegetation mapping, CSIRO Land and Water assessed the acid sulfate soil materials present in different habitat areas, identifying characteristic properties. Soils were recorded and described at each site and total carbon, equivalent calcium carbonate content, organic carbon and total sulphur, with dry bulk density and sulphide sulphur measured on selected samples. 70 sites from Fowlers Bay on Western Eyre Peninsula to Hindmarsh Island near the Murray River mouth were sampled throughout the project.

The field and laboratory analyses were used to develop 10 ASS risk classes shown below. These were assigned to each of the habitat classes and the habitat maps were recoded to instead show ASS risk classes. (*cont. over page*)

	Map Legend	Class Description
1	(a) Actual ASS (disturbed) (b) Potential ASS (disturbed)	Actual acid sulfate soils (existing AASS) Very high risk. PASS in subsoil below 20 cms (up to 1 metre thick) with surface monosulfidic black ooze (MBO)-intertidal. Moderate risk.
2	Potential ASS (mangrove)	Thick PASS-mangrove soil. High risk.
3	Potential ASS (tidal stream)	PASS of tidal streams. Moderate risk
4	Potential ASS (intertidal)	PASS in subsoil below 20 cms (up to 1 metre thick) with surface monosulfidic black ooze (MBO)-intertidal. Moderate risk
5	Potential ASS (supratidal)	PASS in subsoil below 50 cms (up to 1 metre thick) with some surface MBO-supratidal. Moderate to low risk.
6	Sand	Soils of sand dunes, ridges. Low risk
7	Calcerenite	Calcareous soils and hardpans. No or very low risk
8	Marine soils	Marine soils-sub tidal and intertidal marine. No or very low risk.
9	Other soils	Soils associated with other land uses within coastal landforms. Risk requires individual investigation.
10	Soils not classified	Soils outside area of mapped coastal landforms.

For further information contact Doug Fotheringham, Senior Scientific Officer for the Department of Environment and Heritage on (08) 8124 4888 or Fotheringham.Doug@saugov.sa.gov.au

RESEARCH UPDATE

Understanding monosulfidic black ooze

Monosulfidic black ooze (MBO) refers to sulfur and iron enriched organic sediments that commonly form in drainage channels in acid sulfate soil (ASS) landscapes. These sediments are highly mobile and easily incorporated into the water column during floods, where they can rapidly deoxygenate and acidify water.

A current research project of the Centre for Acid Sulfate Soil Research (CASSR) at Southern Cross University in Lismore, in conjunction with the Department of Primary Industries in Wollongbar, will investigate the chemistry of MBO and the factors that affect its distribution.

A detailed examination of the oxidation behaviour of MBOs aims to identify their contribution to poor water quality events associated with drainage in acid sulfate soils, such as the 2001 fish kill on the NSW North Coast. Particular drain management practices e.g. tidal water introduction, and drain clearing



The Centre for Acid Sulfate Soil Research at Southern Cross University is currently researching monosulfidic black ooze.

and reshaping, will also be examined to determine their effect on MBO formation, accumulation and concentration.

A thorough understanding of the chemistry and processes associated with MBOs will aid in identifying appropriate and effective drain management techniques to minimise the export of acidifying and deoxygenating drain oozes.

For further information contact Diane Fyfe at CASSR on (02) 6620 3494 or dfyfe@scu.edu.au

Resources for loan- ASSPRO Honours theses

The NSW ASSPRO Scholarship program has been completed with final funding going to students in 2004. Over seven years, 20 honours theses were completed with funding from the program. Many of the students have gone on to post graduate studies or employment in acid sulfate soil management. The following Honours theses funded by the ASSPRO program are held at the Kempsey office of the Department of Infrastructure, Planning and Natural Resources and are available for loan on request to Glenn.Atkinson@dipnr.nsw.gov.au

Mo-Ane, Rebecca (1998) Further development of a strategy for the management of ASS in Berry, NSW University of Wollongong BE
Thong, Linda (1998) Management of ASS studied in column experiments University of Wollongong BE

Sonter, Liesel (1999) Spatial characteristics of acid sulfate soil-induced estuarine acidification within Cattai Creek UNSW BSc App

Johnson, Phil (1999) The distribution and amount of soil acidity in the lower Cudgen Lake Catchment UNSW BSc App

McArthur, Cameron (1999) Investigations into the impact of acid discharge from a drained coastal floodplain UNSW BSc App

Smith, Jodie (1999) The assessment of spatial variations in actual acidity at McLeods Creek UNSW BSc App

Enman, Brett (1999) The role of fluvial sedimentation in the formation of acid

sulfate soils on an estuarine floodplain
UNSW BSc App

Marston, Helen (2000) Contrasts in the acidity contained in ASS sugarcane landscapes as a function of the method of measurement and landuse BSc App UNSW

Kinsela, Andrew (2001) The spatial and temporal relationships between continuously monitored EC and pH, and measured ionic composition and titratable acidity in ASS drainage waters UNSW BSc App

Rittie, Naomi (2001) The soil and water chemical changes associated with mole drains in ASS sugarcane fields UNSW BSc

Earnshaw, Kate (2001) Remediation and management of ASS using a self regulating tilting weir University of Wollongong BE

Rudens, Chris (2001) The role of biotic oxidation on acid production in potential ASS in the Shoalhaven Floodplain University of Wollongong BE.

Ikin, Darren (2001) Increased effects of saline buffering through reduced stratification University of Wollongong BE

Cannon, Annelise (2002) The effectiveness of floodgate modification in maximising tidal buffering of acid sulfate soil drainage University of Wollongong BE

Donner, Erica (2002) The effects of floodplain landuse on the chemistry and hydrology of coastal Acid Sulfate Soils University of NSW BSc App

Toppler, Nadia (2003) A study in broadacre remediation of acid sulfate soil through the application of lime and mill mud-ash, McLeod's Creek, NSW University of NSW BSc App

Allery, Simon (2003) Sulfide mineralogy, oxidation behaviour and acidification of peat acid sulfate soil materials Southern Cross University BSc

Durr, Mira (2003) The emission of sulfur dioxide from acid sulfate soils in the Tweed region, Northern NSW, Australia Australian National University BSc

Maher, Crystal (2004) Pyrite formation in acid sulfate soils using sulfur isotope ratios Southern Cross University BSc

Kehoe Marion (2004) The role of microbial processes in the formation of acid sulfate soils at Kempsey NSW Australian National University BSc

Websites/Forums

Fish'n'Kids - Educational resource

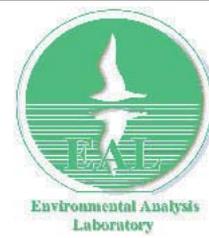
Readers involved with education may find a new edition to the Department of Primary Industries-Fisheries webpage of interest. The new pages have fun facts and activities which encourage children to take interest in fish and fish habitat. Log on to the new pages at <http://www.fisheries.nsw.gov.au/kids/index.htm>

Citizen Science Toolbox - Extension resource

'Community consultation', two words regularly used in natural resource management. Looking for some fresh, innovated ideas on how best to go about it? This website includes a database that will select a range of activities to suit your budget, timeframe and skills.

<http://www.coastal.crc.org.au/toolbox/index.asp>

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Conferences

5-10 December 2004

SuperSoil: Australia New Zealand Soils Conference, Sydney NSW Conference theme is 'human impact and management of soils' with sessions on soils and water quality as well as soils as an ecosystem service. For further information log on to <http://www.icms.com.au/supersoil/>

Publications

Managing floodgated watercourses

Clarence Valley Council has produced an attractive 10-page booklet on managing floodgated watercourses. The booklet is a great general introduction to active floodgate management outlining the potential benefits and different devices that can be installed to allow tidal interchange. Funded by the Environmental Trust, the booklet is packed with colour photographs and has proved very popular with the general public. For copies contact Clarence Valley Council on (02) 6642 3277.

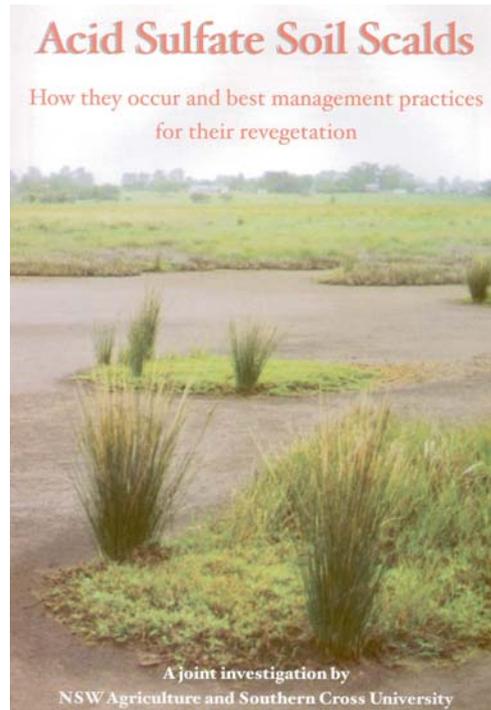
Understanding landholders' capacity to change to sustainable practices

The Bureau of Rural Sciences website has downloadable copies of the above publication. It is an extensive publication that explores what factors influence a family's decision to adopt or not adopt new technology or management options. Download a copy from www.brs.gov.au, under social sciences and then publications.

Scald management booklet - second print run

A second-print run has occurred of the popular booklet Acid Sulfate Soil Scalds: how they occur and best management practices for their revegetation. The booklet, part of an ASSPRO funded project, covers issues such as what are scalds and how did they form, why scalds

should be managed and how they can be revegetated. Along with the booklet, a PowerPoint display and posters highlighting acid sulfate scalds issues are also available. For a limited time, the principal author Mark Rosicky has funding to allow him to travel and conduct presentations to interested groups. Contact Mark Rosicky at mrosic10@scu.edu.au or 0418 495 714



ASSAY

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