LANDSCAPE LOGIC
LINKING LAND AND WATER MANAGEMENT TO RESOURCE CONDITION TARGETS

August 2008 Newsletter • www.landscapelogic.org.au

Contents

LANDSCAPE LOGIC is a research hub under the Commonwealth Environmental Research Facilities scheme, managed by the Department of Environment, Water Heritage and the Arts. It is a partnership between:

- six regional organisations – the North Central, North East & Goulburn–Broken Catchment Management Authorities in Victoria and the North, South and Cradle Coast Natural Resource Management organisations in Tasmania;
- five research institutions – University of Tasmania, Australian National University, RMIT University, Charles Sturt University and CSIRO; and
- state land management agencies in Tasmania and Victoria – the Tasmanian Department of Primary Industries & Water, Forestry Tasmania and the Victorian Department of Sustainability & Environment.

The purpose of Landscape Logic is to work in partnership with regional natural resource managers to develop decision-making approaches that improve the effectiveness of environmental management.
Landscape Logic aims to:

1. Develop better ways to organise existing knowledge and assumptions about links between land management actions and environmental outcomes.
2. Improve our understanding of the links between land management actions and environmental outcomes through historical studies of the effects of private and public investment on water quality and native vegetation condition.

The path from data to knowledge

Prof Ted Lefroy, Director, Landscape Logic

Research in natural resource management is plagued by scale, time lags, a confusion of natural and human influences and an absence of good quality observational data collected at meaningful scales and intervals. For these reasons, it is pleasing to see that at the half-way point in the life of Landscape Logic, we are already seeing signs of impact on several fronts.

The Knowledge Integration team (Project 6), through the work of Carmel Pollino and Jen Ticehurst, is having a noticeable influence on our research teams and our partners as was evident at the recent review of our largest project, the Tasmanian Retrospective (Project 4). Each sub-project presented their hypotheses to the external reviewers in the form of influence diagrams that illustrated their assumptions about key drivers and relationships between land use, land management and water quality within their respective components (land use, freshwater, riparian and estuarine). Having a common language to communicate the view from different disciplines has enabled a complex catchment-wide issue to be broken down to a set of interconnecting systems and focused attention on the critical linkages, such as sources and pathways of nutrients and the relationships between biological and chemical measures of water quality.

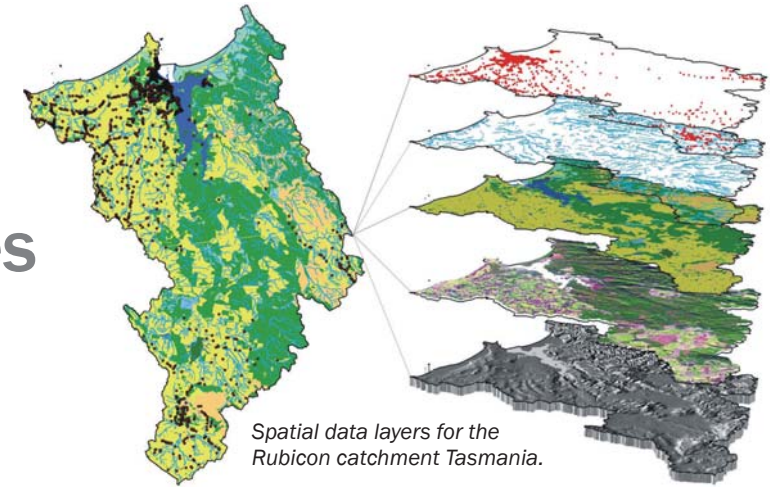
The value of a common language to describe complex ecological and social systems has also been recognised by our regional partners. Several are now using influence diagrams and decision network software, not as was intended to develop specific decision support tools, but to test the logic of their overall investment portfolio and identify those areas in which they are likely to have most impact.

Another piece of work that stands out is the analysis of Tasmania's AusRivAs water quality data set. Nelli Horrigan, working under the supervision of Peter Davies and Steve Read, has identified a disturbance threshold that appears to be a characteristic of Tasmanian catchments (see p.7). Relating survey data on freshwater invertebrates to land use shows that where grazing occupies more than 42% of a catchment, the composition of the more sensitive macro-invertebrate communities declines dramatically. This supports the assumption that prompted our retrospective studies – that relationships of value to management might be lurking within existing datasets. Field work this spring will further explore this relationship and its implications for water quality management.

The big tasks for Landscape Logic remain staying in touch with and relevant to our primary audience, regional natural resource managers, particularly as they undergo organisational change and form new partnerships in the face of new public programs and funding regimes. In principle, our work is becoming ever more relevant as governments demand more accountability for public investment in the environment. In practice our work is becoming ever more challenging as we attempt to distil our understanding down to the simplest possible terms without compromising its rigour. These two examples auger well for our continuing efforts in knowledge integration and knowledge discovery.

To follow up any of the work described in this newsletter, see the contacts listed on page 5.

Project 1: Mapping and databases



Spatial data layers for the Rubicon catchment Tasmania.

P1 recently had its project review, attended by more than 20 people in Melbourne. The meeting was a very positive experience and the proceedings, a compilation of the presentations, will soon be available on the LL website. These will detail many of our recent activities including: database development, native vegetation condition research and remote sensing using laser scanning (LiDAR) to extract vegetation structural composition information.

Gang-Jun Liu has been working on the generation of terrain and climatic surfaces for enhanced landscape level natural resource management. These include state-wide Tasmanian climate and bioclimatic surfaces, including a moisture index. He is currently working on a hydrologically-sound DEM (1:25,000) for the Duck River catchment.

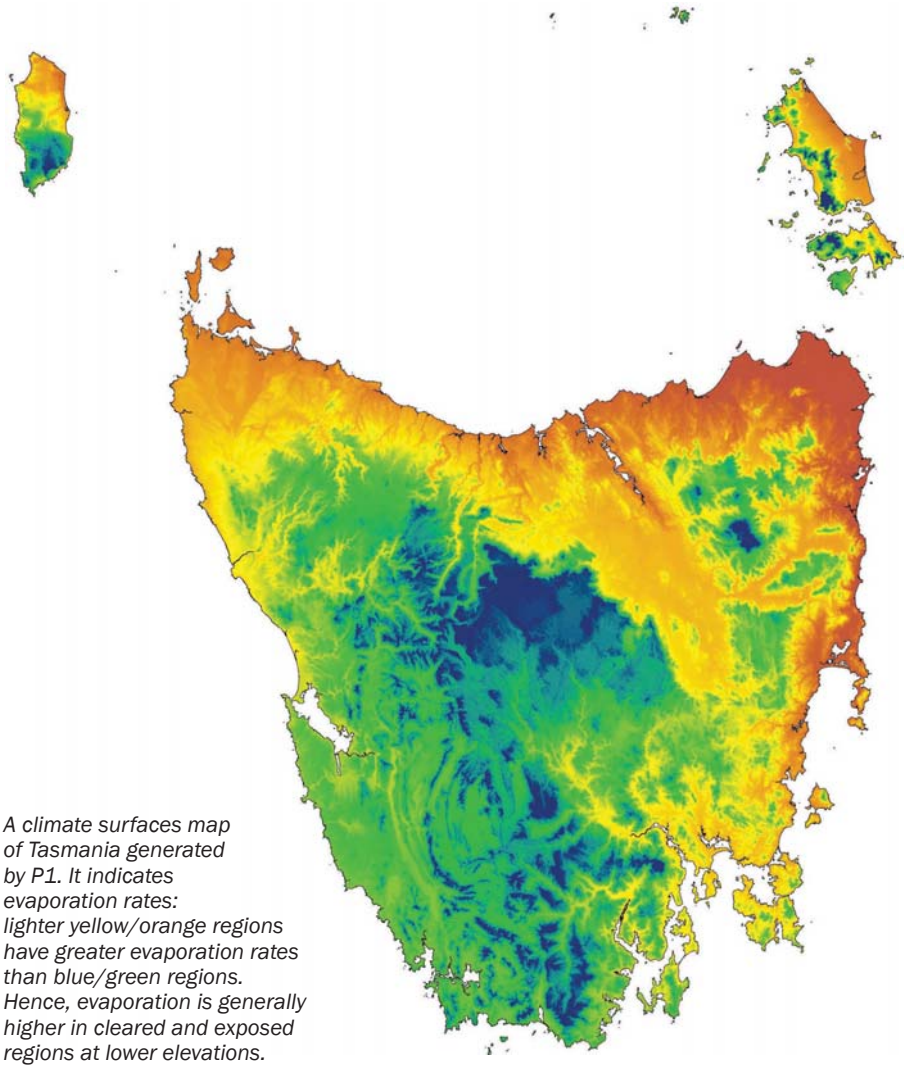
Karyl Michaels, Michael Lacey, Grant Dickins and Tony Norton have been putting together a datasets that will improve regional capacity to make investment decisions to improve extent and condition of native vegetation in Tasmania.

P1 PhD research projects are progressing well and include:

a) experiments in scaling and characterising native vegetation condition and landscape unit extent from patch to regional scale
b) developing fieldwork protocols to support the remote sensing of native vegetation condition
c) testing the utility of laser scanning (LiDAR) to extract vegetation structural composition information, and
d) evaluating techniques for assessing and monitoring vegetation condition, how it influences modelling and its impact under different condition contexts.

Simon Jones and Naoko Miura both recently presented research findings at the International Congress on Photogrammetry and Remote Sensing (ISPRS Beijing, China) whilst Grant Dickins attended the IEEE International Geoscience and Sensing Symposium and Alex Lechner the International Biometric conference.

P1 is also delighted to announce the appointment of a new Postdoctoral Fellow, Dr. Liz Farmer, to be based at the RMIT University.



A climate surfaces map of Tasmania generated by P1. It indicates evaporation rates: lighter yellow/orange regions have greater evaporation rates than blue/green regions. Hence, evaporation is generally higher in cleared and exposed regions at lower elevations.

Project 2: Social research

Purpose

A key focus of the Landscape Logic Social Research project is the social acceptability of land-management practices expected to lead to improved resource condition outcomes at sub-catchment and regional scales. This research will:

- provide better understanding of factors affecting land-holder implementation of recommended practices and the effectiveness of different approaches to land-holder engagement in the management of riparian areas (Tasmania) and remnant bush (north-east Victoria);
- provide knowledge of land-holder adaptation to climate variability (drought and climate change) that could impact on the condition of native vegetation in north-eastern Victoria; and
- enhance the capacity of other project participants and Landscape Logic partners to use social research.

Personnel

There are nine people based at the Charles University in Albury, NSW – Prof Allan Curtis, Project Leader; Dr Digby Race; Dr Catherine Allan, Dr Nicki Mazur, Dr Rik Thwaites, Mr Simon McDonald, Mr Royce Sample, Ms Kris Deegan and PhD student Wendy Minato.

Achievements so far

The social research team commenced work in January 2008 and has effectively engaged with the research activities of the Victorian and Tasmanian Retrospective studies of vegetation change and water quality Integration Project (P6). This work has included developing collaborative research proposals with each project, contributing to development of Bayesian Decision Networks and developing a mail survey instrument exploring land-holder management of riparian areas in Tasmania.

The Social Research team has also recruited a PhD student (Wendy Minato) and provided her with supervisory support. CSU recently advised that Wendy's probationary period has been completed. Wendy's PhD is examining the impact of demographic change on revegetation and testing the assumed links between NRM investments and catchment outcomes. Wendy is also being supported by the Victorian Retrospective (P5) and Integration teams. We have also met with staff from NRM South and NRM North in Tasmania and identified areas where both regions need advice.

Future outcomes

1. Better understanding of:
   - the social acceptability of recommended property management practices assumed to lead to improved resource condition;
   - key factors affecting landholder implementation of recommended property management practices expected to improve water quality (Tasmania) and remnant vegetation (Victoria);
   - the extent land-holder knowledge is consistent with scientific knowledge about the catchment outcomes of property management actions;
   - land-holder adaptations to climate change/variability, including those affecting native vegetation;
   - critical common elements of successful instruments for engaging landholders in voluntary conservation of remnant vegetation;
   - the extent that demographic change is a driver of changes in remnant vegetation condition.
2. Develop a cost-effective approach to land-use history that yields useful insights into the impact of past management practices on the condition of remnant vegetation today.
3. Support NRM regional staff in Tasmania to be confident purchasers of social research expertise.
4. Train a highly competent postgraduate social researcher.

LL staff profile – Wendy Minato

Wendy spent most of her working life as a technician, first at the University of Sydney from 1983, and later at CSIRO Land & Water in Griffith. During those 20 years she was able to work in areas as diverse as microbiology, palynology, algal taxonomy and analytical chemistry.

Wendy completed both her science degree (1988) and honours as a distance student with the University of New England. She majored in Botany and Geography and chose an honours topic in palaeo-environmental history, which involved analysing core samples from a billabong on the Murrumbidgee River.

When the opportunity arose to start a PhD in 2007 she knew that she wanted to combine her science background with the more human dimensions of natural resource management. Wendy liked the multidisciplinary aspect of Landscape Logic and took up a PhD topic combining science and sociology. Her broad research question is: *An exploration of the relative influence of demographic change and NRM investment on improvements in native vegetation condition.* The research methodology will be a combination of quantitative and qualitative techniques but the key component will be in-depth interviews with landholders in the Indigo Valley in north-eastern Victoria. Wendy is currently in her first year of study, based at CSIRO Land & Water in Griffith NSW, enrolled as a full-time distance education student with CSU (School of Environmental Science, Thurgoona campus).

Project 3: Victorian retrospective – vegetation condition

What are we about?

Project 3 – the Victorian Retrospective – is investigating the links between natural resouce management (NRM) interventions and landscape-level change in native vegetation condition. Native vegetation condition involves consideration of both the amount of area covered by native vegetation ("extent") and its relative health or "quality".

Despite considerable investment in native vegetation protection and re-establishment activities through programs such as the NHT and NAP, a recent National Audit concluded that the broader impact of these investments was still unclear.

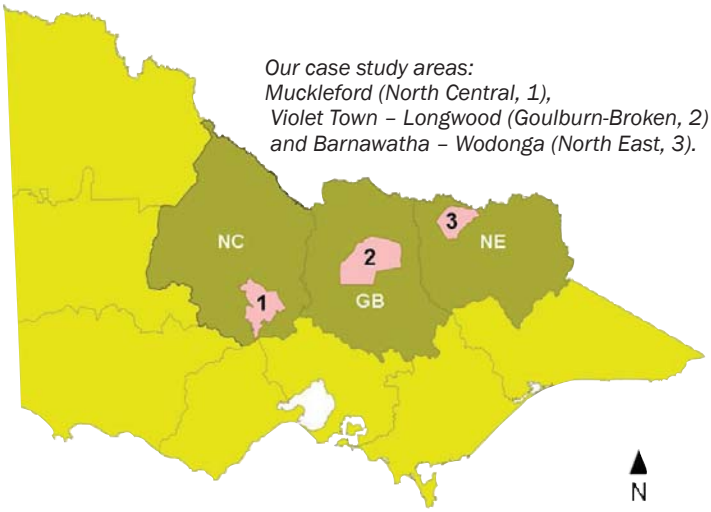
The project is composed of three inter-linked activities that combine site and landscape-level analyses to improve management and reporting of native vegetation condition change:

1. Investigation of historic and contemporary change in native vegetation extent within selected case study areas (above right) through aerial photograph interpretation (API).
2. Investigation of the effectiveness of site-based interventions in improving NV quality through revisiting treated sites.
3. Combine vegetation response models from site and landscape-level analyses with gross land-cover change from API to estimate impact of NRM actions.

Where are we at?

Our work over recent months has been very encouraging as we welcomed new people and collaborations (see box inset), and started to lay rubber on the road with our investigation.

Garreth Kyle joined P3 in late May and has been driving our native vegetation extent change work, comparing aerial photography from the mid-1940s to contemporary images. In preparation for intensive mapping of vegetation change (revegetation, regeneration, and clearing) within our selected case study areas (Fig. 1) we have undertaken a grid search for revegetation, passive regeneration, and clearing (Fig. 2). The grid search covered more than 19% of our case study areas (>5000 km^2 combined area) and will ensure our mapping effort adequately represents zones of native vegetation change.



Our case study areas: Muckleford (North Central, 1), Violet Town – Longwood (Goulburn-Broken, 2) and Barnawatha – Wodonga (North East, 3).

Recently, the team hosted a national workshop entitled *Magnitude and motivations for landholder revegetation and native vegetation improvement actions*, involving researchers and Landscape Logic partners and stakeholders. The workshop explored how our project can benefit from past studies that sought to identify and map native vegetation change, and learn from landholders why they are motivated to undertake such works. Lessons from this workshop will shape our collaboration with Project 2 and be critical in gathering information about property and landscape change in native vegetation.

Undertaking a project such as P3 would be far easier if the location of all the publicly-funded on-ground works were easily accessible. The Catchment Activity Management System (CAMS) was designed to track and report on-ground works in Victoria, but not with research in mind. It is an enticing prospect to find NRM intervention sites using CAMS. Unfortunately, the data contained within CAMS is reputedly patchy and it's difficult to know its limitations.

Stephanie Spry's project is an assessment and audit of CAMS data for our case study areas. This will help us identify which revegetation and remnant protection sites we locate using API were co-funded by government. Steph's project will also have further benefit in helping other researchers understand how CAMS operates, its strengths and weaknesses.

Historical vegetation data

Starting in spring 2008 we will revisit the first BushTender sites, established in 2001 in the North East and North Central CMAs. Vegetation assessments were carried out at the time, however, they were relatively coarse categorical data. Unsuitable historic data presents a common difficulty for after-the-fact monitoring or assessments, and P3 hopes to make important advancements in this area.

One angle will be our support of Chris Jones' Masters project at Melbourne University. Chris is investigating the ecological effectiveness of grazing restrictions in riparian vegetation. In June 08, Libby Rumpff completed an opportunistic pilot study aiming to test a field method for detecting fine-scale changes in vegetation composition and structure. This

study demonstrates that our method, with some amendments, can form the backbone of a field technique to support learning about the effectiveness of native vegetation management at the site level. Libby has now commenced a shared position between Landscape Logic and the AEDA CERF which aims to set up an adaptive management case study within the Goulburn Broken catchment.

It is really pleasing to have a strong sense of momentum. This update should give you some sense of what is going on, but it is not exhaustive by any means. We're looking forward to our technical review in September, and the months ahead.

For further information about Project 3, contact David Duncan postdoctoral researcher, by email at david.duncan@dse.vic.gov.au or by phone at (03) 9450 8750.

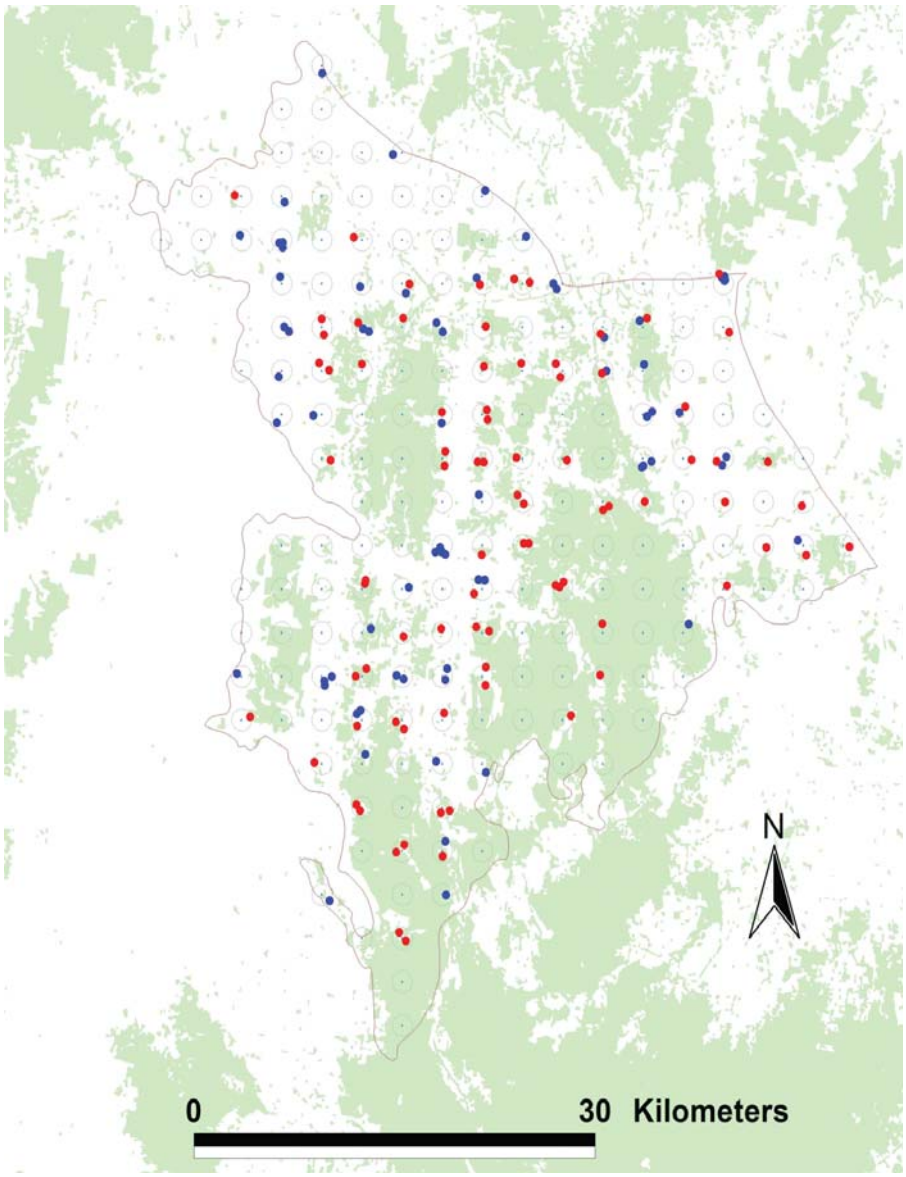
The Project 3 Team

Leadership
Adam Hood (Natural Resources Monitoring & Reporting, DSE)
Graeme Newell (Arthur Rylah Institute for Environmental Research, DSE)

Post-doctoral research
David Duncan & Garreth Kyle (both Arthur Rylah Institute for Environmental Research, DSE)
Libby Rumpff (Landscape Logic P3 and AEDA CERF, Melbourne University)

Masters Student
Chris Jones (University of Melbourne, principal supervisor Dr Peter Vesk)

Project and field team
Stephanie Spry (DSE/DPI graduate program, Sustainable Landscapes, DSE)
Geoff Sutter (Arthur Rylah Institute for Environmental Research, DSE)
Erin Smith (La Trobe University Cadet)



Results of grid search within Muckleford case study area (NCCMA) for locations of suspected revegetation (red) and passive regeneration (blue) from contemporary aerial photography.

Landscape Logic – www.landscapelogic.org.au

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Retrospective Tasmania (Project 4)	Dr Bill Cotching	Project Leader	(03) 6430 4903	bill.cotching@utas.edu.au
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Knowledge Integration (Project 6)	Dr Tony Jakeman	Project Leader	(02) 6125 4742	tony.jakeman@anu.edu.au
Knowledge Broking (Project 7)	Dr Geoff Park	Project Leader	0418 138 632	geoff.park@nccma.vic.gov.au

Sub-Project 4.1: Tasmanian retrospective – Land-use and management

Purpose

To quantify the effects of land use, land management practices and natural resource management interventions on water quality in Tasmanian catchments. Research will be undertaken at a range of scales from local management units (coups and paddocks) to sub-catchment and catchment. Outputs from historic data assessment, modeled information and new studies will be used. This is part of the Tasmanian retrospective project that is investigating the effects of land use and land management on water quality, river condition and estuarine health, led by Dr Bill Cotching (Tasmanian Institute of Agricultural Research–TIAR/CSIRO).

Personnel

There are two staff based at the Cradle Coast campus of the University of Tasmania in Burnie – Dr Bill Cotching, Project Leader, and Dr Shane Broad, Post-Doctoral fellow. Dr Shaun Lisson is at CSIRO/CSE at the Sandy Bay campus of the University of Tasmania.

Achievements so far

Detailed analysis of data from 11 catchments has been undertaken to produce initial estimates of annual phosphorus loads delivered to the estuaries. These are the Inglis–Flowerdale, Meander, North Esk, South Esk, Pipers, Great Forrester, Brid, Ansons, Duck, Montagu and Rubicon catchments. This modelling was based on the Catchment Management Support System (CMSS) model with verification using observational data from State of the Rivers reports.

Modelled data was also produced using a flow–concentration model with verification from ABS statistics on fertiliser use. Generation rates of total Phosphorous, dissolved reactive P, total Nitrogen, Nitrite N, Nitrate N, and ammonia N from different land uses have been calculated. The data outputs have identified rates of nutrients generated by different land-uses in Tasmania that are verified by measurements in the data records of the Tasmanian Department of Primary Industry and Water. We have now identified the land-management practices that are likely to be driving these rates.

Project 4 has also engaged Jessica Coad to assemble and evaluate information from six catchments in Tasmania where riparian intervention has occurred over the past 10 years. These are the Inglis, Pet, Quamby, Macquarie, Jordan and Coal catchments. Summary reports outlining the works undertaken, water quality data available and works undertaken that relate to water quality sampling points for each catchment have been prepared and presented to Project 2 staff. An MSc Student, Suresh Panta, has begun a study entitled 'Quantifying the effects of past land management interventions on water quality in the Coal River catchment'.

An initial Bayesian Decision Network (BDN) has been drafted and this had been refined to reflect detailed understanding of processes affected by land use and land management that contribute to water quality.

A new study to be undertaken by Dr Shaun Lisson (CSIRO Sustainable Ecosystems) and Dr Bill Cotching (TIAR) has been outlined which will assess the risk of leaching and nutrient loss under current intensive cropping systems on soils in the Rubicon catchment, north-west Tasmania.

The land-use and land-management information will provide an understanding of what regional natural resource management agencies are able to influence and what may be beyond their scope of influence. Quantifying the impact past interventions have had on water quality will help to determine the location and scale of intervention required to make a measurable difference.

Outcomes with other projects

Modelled annual nutrient loads for each of the 11 catchments of joint interest will be supplied to sub projects 4.2 River Health and 4.3 Estuarine Health as well as for specific sampling points of interest in 4.2.

Lists of farmers within each catchment where riparian intervention has occurred over the past 10 years were prepared for use by Project 2. Bill Cotching met with Allan Curtis and Digby Race to outline the requirements for social research aligned to the Tasmanian Retrospective study. A Bayesian Decision Network workshop was held in Hobart with Project 4 and 6 staff in November 2007. Initial drafts of Land management/land-use, river health and estuary health networks were developed and are in the process of being updated.

Future communication with regions

Projects 4 and 5 held a working session on August 5 to discuss progress in the water-quality area and explore how we can strengthen inter-project relationships. NRM regional staff attended to discuss first hand the progress being made in our study catchments.

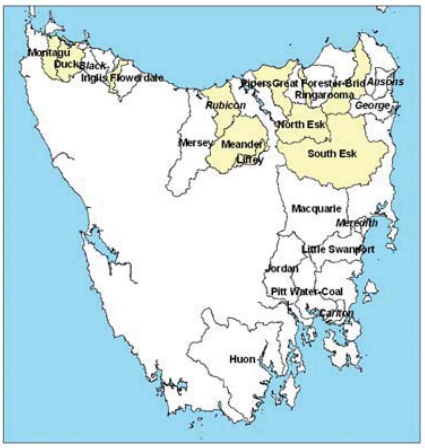
Sub-project 4.2
Freshwater health

The data mining stage of this project is now completed and the results presented to a review of Project 4 in early August

This study examined the relationships between land-use (as well as geomorphology, habitat and water-quality descriptors) and biological indicators of river health in Tasmania using the Australian River Assessment System (AusRivAs) dataset (1999–2006).

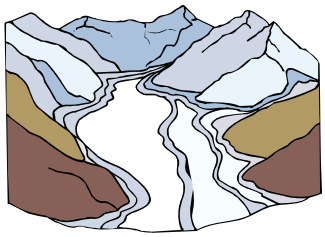
Multivariate and correlation analysis has shown that the majority of biotic indicators considered, as well as structure of macroinvertebrate communities, responded strongly to the increase in the percentage of land used for grazing, particularly modified pastures. Additional analysis of data split by different hydroregions as well as partial redundancy analysis designed to account for the effect of natural gradients confirmed this pattern.

Stronger correlations between land-use and biological indicators were found at catchment-scale rather than local scale (1km above the sampling site). Regression tree analysis suggested a threshold potentially useful for environmental managers. In particular it showed that above approximately 42% of a catchment under grazing results in strong detrimental effect on river health. A new sampling survey for the coming spring season is currently being planned.



Catchments selected for sub-project 4.1 modelling of nutrient generation rates.

Primary researcher in sub-project 4.2, Nelli Horrigan.



Sub-Project 4.3: Estuarine ecology

This project, led by Christine Crawford, aims to link land-use, and resulting changes in water quality and quantity to the health of estuarine ecosystems. Maintenance of estuarine health is very important because over 75% of the Australian population is concentrated around estuaries.

Also, because estuaries are the downstream end of accumulated pollutants from a river system, they are potentially the most representative system of impacts and change derived from land-based activities. Relationships between land-use, water quality and quantity and a variety of indicators of estuarine health will be explored statistically using existing and new data, as well as from paleo-ecological studies.

Water quality and estuarine health data collected from 22 Tasmanian estuaries in the mid–late 1990s will then be compared with data collected as part of this project in 2008–09 to assess the response of estuaries to land-use change at regional and catchment scales as a result of investment in natural resource management over the last 10 years or so (carried out by John Gibson and Jeff Ross).

Levels of change, derived from relationships between indicators of estuarine health and various water quality parameters, will be used to develop resource condition and water quality triggers for estuaries in Tasmania. More detailed information on estuarine health, including measures of key ecosystem processes (e.g. benthic and pelagic production/respiration, denitrification, by our postgraduate students Stephen McGowan and Jason Beard) will be collected in the one or two catchments. This will allow more detailed evaluation of the proximal effect of land management interventions on river and estuarine health.

Importantly, it is also testing how well the indicators recommended for monitoring in Tasmanian estuaries describe estuarine health and what the appropriate spatial and temporal scales for monitoring are.

A paleo-ecological study by Barry Gallagher will allow us to examine relationships between land-use change and estuarine condition beyond our data records, reconstructing a history of estuarine condition back to European settlement from a range of proxies preserved in the sedimentary record.

Sub-Project 4.4 Riparian nitrogen buffering

The broad aims of this project are to understand the nitrogen filtering function of riparian buffers and to develop quantitative predictions of their effectiveness for a wide range of conditions. A model has been identified that offers this potential by including denitrification and plant nitrogen uptake but it requires adaptation and validation. A knowledge base of hillslope and head-water stream nitrogen dynamics is being developed on an extensive grazing property in southern Tasmania and using available literature from key international studies. These local and international data will provide the opportunity for validation of the model. If successful, the model will be applied in at least one other Tasmanian catchment and we intend to use it to develop simple quantitative guidelines on buffer effectiveness for a wide range of environments. Using this tool, we expect to be able to design buffers with prescribed levels of effectiveness for filter nitrogen from up-slope sources.

Plantation buffering

The research is being conducted by CSIRO and it complements a related project in the Forestry CRC that is examining various aspects of the use of commercial trees in riparian buffers on cleared farm-land. The CSIRO team includes Kevin Petrone (hydrologist), Craig Baillie (technician), Auro Almeida (tree growth modeller), Jody Bruce (GIS services), and Philip Smethurst (soil and water scientist and sub-project leader). The team is Hobart-based, except Kevin who works in Perth and visits regularly.

Nitrogen sampling

Stream nitrogen sampling has commenced and a riparian buffer is currently being established in the small headwater catchment where we are focusing this research. A riparian buffer shown below was established last year on another part of the farm. This photo shows how the buffer excludes cattle from the stream-side zone. The buffer design for this farm generally consists of, on both sides of the stream, two inner rows of blackwoods (*Acacia melanoxylon*) and two outer rows of bluegums (*Eucalyptus globulus*), both of which are intended to be pruned and thinned for saw-log production. Spot cultivation and weed control has assisted successful early tree establishment and the remaining weed cover (mainly grasses) probably acts as a very effective sediment trap.

A riparian buffer excluding cattle from the stream-side zone. The buffer design for this farm, on both sides of the stream, generally consists of two inner rows of blackwoods (Acacia melanoxylon) and two outer rows of bluegums (Eucalyptus globulus), both of which are intended to be pruned and thinned for saw-log production.

Project 5
Catchment nutrient and sediment management – Sources, sinks and flow paths

In making decisions about natural resource management (NRM) investments and improving the condition of natural resources as effectively and efficiently as possible, catchment management organisations need to determine:

- where in the landscape to target specific NRM interventions related to water quality
- how to decide on appropriate water-quality management options in an identified location; and
- how to assess the impact of such interventions before and after implementation.

Project 5 addresses these needs by developing and evaluating new methods to identify likely critical source areas for nutrients and sediments and build spatial, conceptual 'models' of nutrient movement through the landscape and into rivers.

A major focus in Project 5 is the study of high-frequency water-quality monitoring. The hypothesis is that high-frequency data may contribute important new information on the links between land-use management and water-quality impacts. There are a few published studies that suggest this may be so. However, these methods are not established for larger catchments with multiple land-use and have not been evaluated in Australia. Our research will enable determination of the *minimum* level of temporal sampling intensity that would be required to adequately monitor catchment processes. This is significant in the design of monitoring programs.

The high-frequency monitoring is complemented by a spatial assessment of critical source areas from 'first principles' and through applying methods to disaggregate the catchment into so-called hydrochemical response units. These are landscape units that relate to dominant hydro-chemical process dynamics. Other spatial information is obtained by longitudinal sampling (sampling along the length of the river and its tributaries) and targeted spatial modelling analyses.

Information about the origin of nutrients is explored using isotope analyses. Together these multiple 'layers of evidence' aim to capture how a catchment functions: which nutrients contribute to water-quality problems; what is their origin; where are their critical source areas; and what hydrological pathways transported the materials to the waterways?

The Duck River catchment in north-west Tasmania is the focus catchment for the experimental work in Project 5. To transfer the knowledge we gain in the focus catchment, the project also seeks to determine: how best to ascertain how a catchment functions; what types of monitoring data provide the highest information content; and at what spatial scale and temporal frequency? For this purpose the project will deliver monitoring design principles and methodology for developing spatial conceptual models of catchments for use by regions and government agencies.

Submersible spectrophotometer.


Fully automatic mini lab. The equipment measures total phosphorus, total nitrogen, nitrate, nitrite, ammonium and phosphate. It can take measurements as frequently as every 15 minutes.

Project 6: Knowledge integration

Purpose

To develop decision support systems, based upon Bayesian Networks (BNs), to capture current understanding of how the regions' investments contribute to changing resource condition in light of the variation in external factors including climate and social change. The networks will also incorporate the inevitable uncertainty that surrounds environmental management, the associated processes and information. These decision support systems are being developed with catchment managers to ensure they meet their practical needs.

Expected outcomes

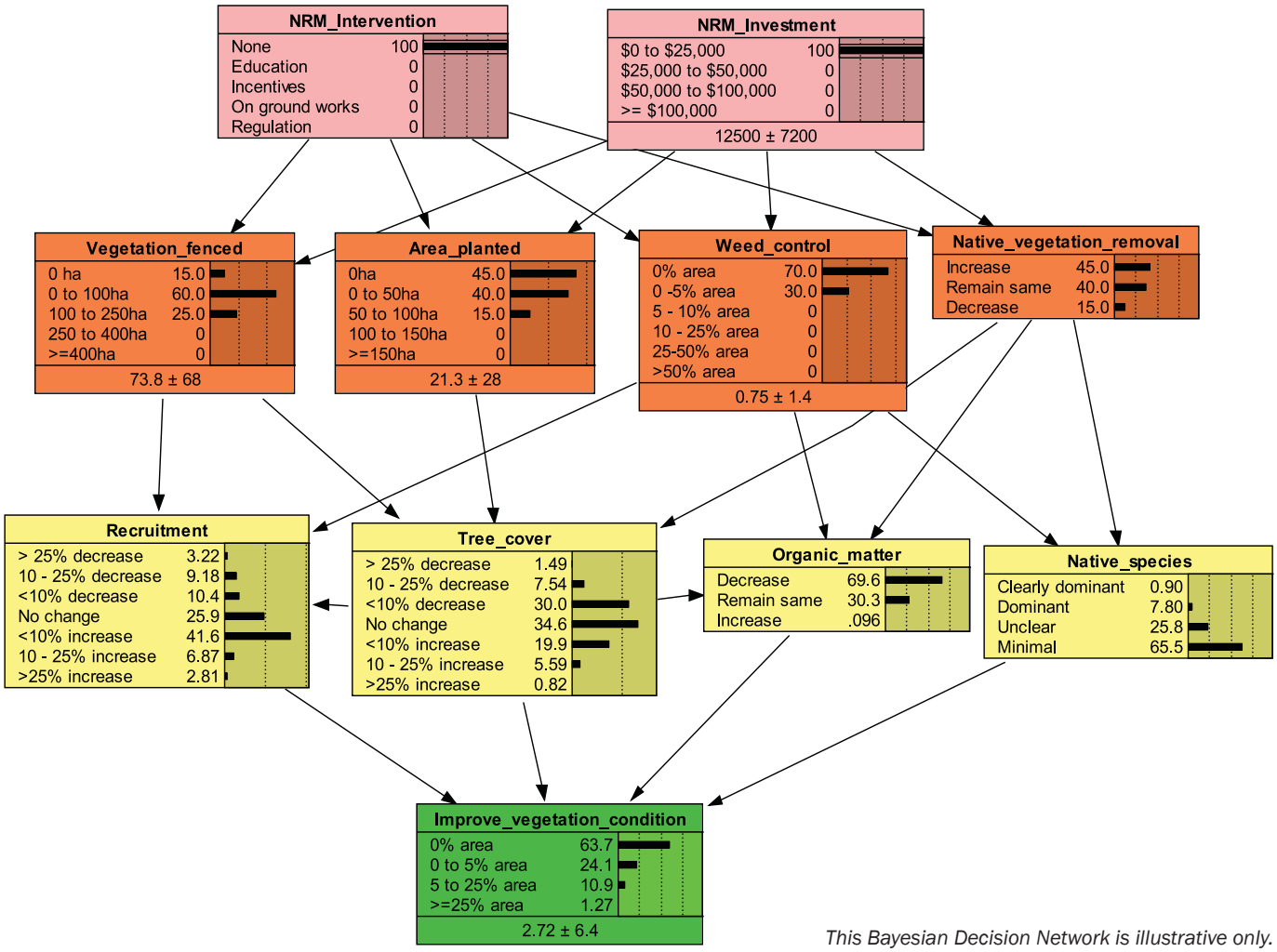
Decision support systems to assist in targeting investment and reporting on resource condition outcome for water quality and quantity and vegetation condition. As a consequence of the development of BNs, the following outcomes should also be realised:

1. Improve systems thinking by research scientists and regional staff, through the training and experience in the development of BNs, a comparatively simple systems-based approach to representing complex issues.
2. Provide a means to facilitate discussion on complex systems between research scientists, and between scientists and regional staff, through the BN development process.
3. Provide a knowledge management system for the regions to document current assumptions and understanding of their systems, catalogue a library of relevant reports and information they have for particular issues, and to target future research and monitoring investment.
4. Improve understanding of how best to engage with the regions is order to improve adoption of new skills and techniques.

Joint outcomes with other Landscape Logic projects

The development of the decision support systems (Outcome 1 from above) is fundamentally dependent upon working jointly with the knowledge discovery teams (Projects 2, 3, 4 and 5), to provide scientific rigor, the spatial team (Project 1), to provide the required spatial input data and output maps, and the knowledge broking team (Project 7) to assist in liaising with the regions.

In addition, other Landscape Logic projects are involved in outcomes 2 and 3 given above, particularly the



This Bayesian Decision Network is illustrative only.

knowledge discovery and knowledge broking teams.

Achievements so far

Project 6 has provided the regions with training in the development of BNs.

This has resulted in some of the regions applying a systems approach to their current planning and reporting. Some of the regional staff have stated the benefits of using their new skills, despite not having developed or utilised a completed BN. For example, systems thinking skills have assisted regional staff in facilitating processes for identifying the key drivers over which they have influence, and those that are the responsibility of other bodies.

As a consequence of BN training, the regions now have a common language which enables them to contribute more critically to the development of BNs for decision support. This will result in more relevant and useful outputs for the regional partners and Landscape Logic as a whole.

Project 6 provides the knowledge discovery teams with progressive training and experience in the development of BNs.

Similar to the regional staff, many of the Landscape Logic researchers have benefited from improving their systems thinking skills, which can assist in identifying how their expertise can contribute to a broader level of management used by the regions.

The BN process has also forced researchers to formalise their understanding and expertise, and assisted in establishing linkages between Landscape Logic projects and sub-projects.

The BN development process provides a focused framework for both the researchers and the regions to discuss critically and evaluate within the context of their personal knowledge, experience and requirements. This process has been aided by both groups having been trained in developing BNs early in the project.

Research in Project 6 has contributed to the challenge of linking the outputs from water-quality modelling and economic valuation techniques using BNs. A prototype of this approach is under development in the Georges Bay catchment in north-east Tasmania. This demonstration of a means of sensibly linking otherwise disparate approaches is of great interest to the regions and to other Landscape Logic projects.

To date, the training and supervision of the regions in developing their own BNs (*capacity building*) has had limited success. This has been attributed to the resources (particularly regional staff time) that is required to fully develop and apply a BN. From the capacity-building exercise we have learned that:

- Regional staff can benefit from the early stages of the BN development process by learning how to frame problems, without knowing how to develop a fully operational BN
- Those regions that sought additional funding for projects based around BNs were able to contribute greater resources to the process, and
- In future, a more formal agreement with the regions may be necessary to secure increased staff time to dedicate to the learning and adoption of new skills.

Key stages to communicate with the regions

In the next 12 months it would be useful for the regions to offer feedback on the further development of the BNs, the spatial and temporal scale with which they desire information, and how they would like the information to be presented. More specifically, this would involve:

- Late this year or early next year, a workshop will be run for the regions to provide feedback on the vegetation condition and social change information collected to date and the spatial and temporal scales at which they require information to assist in investment, planning and reporting. The researchers will use this as an opportunity to comment on what they can provide and what compromises may be necessary.
- The next workshop for the Tasmanian retrospective study will be conducted in September 2008. This workshop will focus on how data can be entered into the existing BN frameworks. Regional bodies will be invited to contribute to this process.
- Our economic valuation work in the Georges Bay area will involve extensive surveying over the next several months of the values held by the local community.

Project Leader, Professor Tony Jakeman

Project 6 Personnel

There are nine people in the team based at the Australian National University in Canberra:

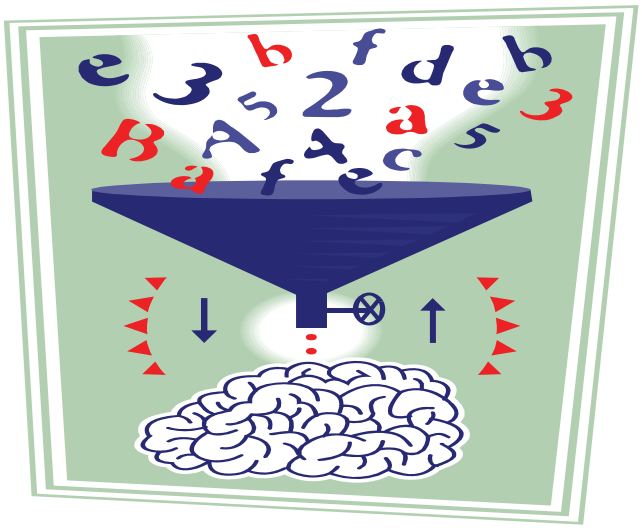
Project Leader,
Professor Tony Jakeman;

Post-doctoral fellows:
Dr Carmel Pollino,
Dr Jenifer Ticehurst,
Dr Lachlan Newham, and
Dr Wendy Merritt.

Research fellows:
Professor John Norton,
Dr Rebecca Kelly (Letcher).

PhD students:
Marit Kragt and Serena Chen.

Project 7: Knowledge broking



Purpose

Project 7 is responsible for ensuring a shared understanding of Landscape Logic project purpose, activities and outcomes amongst the partners and managing an outreach and training program for partners and other regional organisations

Personnel

Geoff Park – Project Leader, is based at North Central CMA in Bendigo and Greg Pinkard is with the University of Tasmania in Launceston. Greg joined Landscape Logic in late April this year after some 33 years with the Tasmanian Department of Primary Industries and Water.

As Landscape Logic passes the halfway mark our research projects are beginning to develop momentum and interim outcomes. It's exciting to see the early signs of tools, products and information for uptake by our end-users – especially our partner regional NRM bodies.

At the regional level there have been a number of developments with major significance for the way regional NRM bodies do business. In particular the new Commonwealth program, Caring For Our Country, is focusing on improving the effectiveness of investment in achieving environmental outcomes – exactly the domain of Landscape Logic.

The Victorian government is currently developing a white paper on land and biodiversity which has major implications for regional NRM planning and investment. Again the focus of our research and adoption in Landscape Logic meshes well with this process.

The Knowledge Broking team of Greg Pinkard and Geoff Park is working hard to maintain regular involvement with both regional groups and research teams to support effective two-way communication, engagement and interaction about regional developments and research directions.

Geoff has been assisting David Duncan and his team, including Stephanie Spry and Garreth Kyle, with the Victorian retrospective study. This has involved the development of the catchment selection documentation for the study areas in three Victorian CMAs focusing on change in vegetation extent and condition. A development that will be of interest to many is the loading of time-series aerial photography (beginning with runs from the late 1940s and early 1950s) into the web-based GIS tool eFARMER. This will enable easy access for catchment planners to this important resource for P3 case study areas and enable comparison with current spatial layers.

Geoff also recently assisted with the P3 workshop on magnitude and motivations for landholder revegetation and native vegetation protection and enhancement held in Melbourne on 3 July. There was excellent representation from regions (Victoria and Tasmania) at this workshop and it was a great opportunity to look at a range of approaches to eliciting landholder/project information on native vegetation.

The North Central CMA is just finalising a key project, Climate Change and Ecosystem Risk, involving a number of our Landscape Logic partners including DSE (Arthur Rylah Institute) and Charles Sturt University. The project focuses on ecological and sociological aspects of climate/ecosystem interactions. Work led by Graeme Newell and Mat White from DSE has produced some fascinating modelling outputs for the responses of selected biomes (vegetation associations) across northern Victoria to future climate scenarios.

This has been combined with social research (led by Rik Thwaites and Allan Curtis at CSU) examining landholder attitudes and likely management actions for native vegetation according to their understanding and perceptions of climate change. For copies of the report when it is available you can contact Geoff Park or Rohan Hogan at the North Central CMA.

To date Greg Pinkard has been working with Bill Cotching and Kirsten Verburg and their teams in Projects 4 and 5 to ensure effective interaction and exchange of information and knowledge between these projects, the three Tasmanian NRM regions and the state government. Part of this work has been aimed at gaining a clear understanding of the outcomes (e.g. products, tools, knowledge, data) likely to be developed by these two projects.

In addition, Greg has provided assistance to Allan Curtis and his team in Project 2 in the development and trialling of a landowner social research questionnaire. Another key ongoing role for Greg is to assist with obtaining data-sets and layers from DPIW for use by Projects 1, 4 and 5 and ensuring there is close interaction between Landscape Logic and the Tasmanian NRM Data Library project (a joint project between the three Tas NRM regions and DPIW).

The next 12 months will see the Knowledge Broking Project (P7) play an important role in working with all Landscape Logic projects and our partners (especially the NRM bodies) to ensure there is a close alignment between research findings and end user needs.