

Institute for Land, Water and Society

Research Quality Evidence Portfolio 2006

The Institute for Land, Water and Society (ILWS) was established in 2005 with the aim of becoming an internationally recognised research group. Our principal focus is on integrated research that contributes to improved social and environmental sustainability in rural and regional Australia. By mid 2006, ILWS had 59 Members (based on CSU research active criteria), 91 Associate Members and 59 PhD students. Twenty-four members received CSU Principal Researcher status in 2005 on the basis of their research standing. ILWS members include social, economic and environmental scientists. In 2005, ILWS members were awarded \$2.23 million in research grants and had publications that were awarded 67 DEST points.

The 2004 ILWS Accreditation bid to CSU identified four key theme areas for ILWS research. These were:

1. Irrigation systems in a catchment context
2. Landscape, biodiversity and riverine systems
3. Social and economic dimensions of sustainability
4. Policy and integration.

As ILWS members and our Advisory Board addressed the challenges of integration we established five disciplinary-based communities of scholars and three large integration programs. The three new Integrated Programs established in mid-2006 are:

1. The sustainable management of key environmental assets in the central Murray-Darling Basin.
2. The implications of social and demographic change for land management in rural Australia.
3. Tools and methods for comprehensive environmental accounting: focussing on social and economic dimensions and integration across the triple bottom line.

The 2006 ILWS Research Quality Portfolio includes Portfolios from two research groupings:

1. The social and economic dimensions of regional sustainability
2. The ecology and biodiversity group.

The Ecology and biodiversity group is an active community of scholars in ILWS. The Social and economic dimensions group is drawn from Principal Researchers across three communities of scholars spanning the Human dimensions of environmental management, Rural social research (with an emphasis on social welfare), and Environmental economics and regional development.

Research Grouping # 1

Social and economic dimensions of rural sustainability Evidence Portfolio

Context statement

The Social and economic dimensions group comprises five Principal Researchers across the Human dimensions of environmental management, Rural social research (with an emphasis on social welfare), and Environmental economics and regional development communities of scholars. The five researchers are: **Professor Allan Curtis, Associate Professor Ian Gray, Associate Professor Mark Morrison, Professor Eddie Oczkowski and Professor Kevin Parton**. Each Principal Researcher has a strong track record of publications and competitive research grants and currently leads a substantial team of researchers, including Doctoral students.

Since the inception of ILWS, each of the Principal Researchers has contributed to the development of ILWS themes and more recently, the Integrated Programs. These interactions have led to collaborative projects. For example, Professor Parton and Professor Curtis were recently awarded a nationally competitive grant through Land and Water Australia to *Explore business process improvements for quality regional NRM service delivery*. Associate Professor Ian Gray and Professor Curtis have been awarded nationally competitive grants (ARC and LWA respectively) to explore aspects of regional governance and will collaborate on a 2007 national conference examining regional transport systems. Professor Oczkowski, Associate Professor Morrison and Professor Curtis have worked together as part of larger multi-disciplinary teams in ILWS, including with members from the Ecology and Biodiversity group, to develop project bids to the National Water Commission related to the management of key environmental assets.

A common thread through the work of each Principal Researcher in the Social and Economic Dimensions group is that they are focussed on strategic and applied research that addresses regional sustainability issues. For Professor Curtis the focus is on understanding the contribution of local watershed organizations to rural development and identifying ways to sustain them over the longer-term. Professor Curtis' research into Landcare and catchment management has also focused on governance principles and this is a key focus of the work of Associate Professor Gray. Professor Oczkowski is an expert in the development and application of statistical techniques to analyse agricultural markets. His research expertise has been applied to a range of topics, including to the potential for agricultural cooperatives to prevent some of the negative social and economic impacts for farmers and regional communities as a result of the market power exercised by agribusiness corporations. Professor Parton and Associate Professor Morrison have applied their expertise to areas of environmental economics, including to the impacts of climate change, and in Professor Parton's case, also to regional health issues arising from climate change.

Collectively, the social and economic researchers in ILWS are the largest single group of researchers focused on these aspects of sustainability issues in Australia. We would argue that we are recognized as national leaders in our fields and that we have strong international standing. Our supporting evidence includes:

1. the degree of innovation in our research and the contributions of our findings to larger bodies of research;
2. the reputation for quality of the journals where we have published and the extent that our work has been cited by others;
3. our ability to attract nationally competitive grants to support our research, including through the Australian Research Council;
4. the extent that other academics want to join with us in collaborative work; and
5. the extent that our methods and findings have been recognized by governments and management agencies.

Rather than repeating the evidence provided in the individual sections of this group portfolio, we highlight some important examples of this evidence of quality. We also want to draw the reviewers' attention to the fact that journals publishing social/ economic research have much lower impact factor ratings than do journals publishing in fields such as ecology or medicine. As a general rule, a rating above 0.6 indicates a higher quality social/ economic research journal. For example, Professor Curtis and Associate Professor Morrison list papers published in the *Journal of Environmental Management*. This is the most prestigious journal addressing multi-disciplinary themes in environmental management and has an impact factor of 1.163. On the other hand, Professor Parton published one of his papers in the *Journal of the American Medical Association* that has an impact factor of 23.332.

Professor Curtis' research on Landcare is the largest (25 peer-reviewed journal papers and 6 book chapters since 1995) and most comprehensive body of work on these organisations in Australia and of similar organisations in any developed economy. His seminal paper providing a methodology for exploring the effectiveness of these organizations was published in the leading international journal in this field; has been widely cited by other researchers (ISI 16, Scopus 28); was published in a selected edition of papers from across all Edward Elgar publications; and has underpinned subsequent evaluations of the National Landcare Program in Australia.

Associate Professor Gray's 2005 paper on 'Local leaders in a global setting: dependency and resistance in regional New South Wales Newfoundland' drew on research funded through the Australian Research Council and the Australian Social Sciences Academy, involved collaborations with other leading Australian researchers and was published in a high quality journal (*Sociologia Ruralis*).

Associate Professor Mark Morrison's 2002 paper in the *American Journal of Agricultural Economics* presented findings from the first study to demonstrate the advantages of choice modelling for measuring benefit transfer. Since this paper was published choice modelling has become the industry standard. Twelve other published studies have followed this seminal study (with almost all citing it). The AJAE is the world's leading agricultural economics journal (impact factor 0.967) and the paper has a high rate of citation (10 Scopus citations).

Professor Oczkowski has made a major contribution to the development and assessment of the statistical properties of techniques for discriminating between statistical models which use competing measurement scales. This work is applicable to various disciplines where measurement scales are used in developing models. One of his papers was published in *Structural Equation Modeling* which has a very high citation index of 1.583 and is ranked 7 of 32 journals addressing Social Sciences Mathematical Methods.

Professor Parton's papers exploring the impact of climate on health established that in certain locations there is a lag of several months between weather events or weather indices like the SOI and the health impacts of various vector-borne diseases. His 2003 paper with Dr Bi Ping on Climate variations and the transmission of Ross River virus infection in coastal and inland regions of Queensland--an analysis from Townsville and Toowoomba, was published in *Environmental Health*.

Each of the Principal Researchers has an established international presence, including through research collaborations, contributions to international fora and international scholarly communities. For example, Associate Professor Morrison is currently working with Professor Kevin Boyle (Virginia Tech) and Associate Professor Laura Taylor (Georgia State University) on research funded by the US EPA and the National Science Foundation to increase the accuracy of choice modelling studies by the inclusion of provision rules. Professor Parton's research with Dr Bi Peng, University of Adelaide includes studies of climate change on agriculture and health in China. Professor Parton has other research underway in the Philippines (funded through the Australian Centre for International Agricultural Research) and has previously worked Ethiopia, Kenya, Pakistan, Bangladesh, Indonesia, Thailand, Papua New Guinea, New Zealand, Canada and the European Union. Professor Curtis has research experience in the United States and recently hosted Professor Bruce Shindler from Oregon State University. Professor Shindler contributed to a multi-disciplinary forum in Albury that identified research opportunities for ILWS and Oregon State social researchers on the topic of wild fire management. Professor Shindler has undertaken large National Science Foundation funded projects on this topic. Professor Curtis has recently been appointed the Associate Editor (Social Sciences) for the Journal of the American Water Resources Association, the leading multidisciplinary watershed research journal in North America.

Associate Professor Ian Gray is currently a partner in a large ARC project examining aspects of regional governance in Australia that includes Griffith University researchers. Publications included in Professor Gray's portfolio involved collaborations with leading social researchers at Monash University (Professor Chris Cocklin) and University of Queensland (Professor Geoff Lawrence) as part of research funded by the ARC and the Australian Social Science Academy. Associate Professor Morrison's portfolio includes papers based on a number of collaborative projects with Professor Jeff Bennett (Australian National University). He is also engaged in collaborations with CSIRO scientists, including Dr Darla Hatton McDonald and with Dr Steve Hatfield-Dodds. His work with Dr Hatton includes project work and co-authorship of papers examining aspects of non-market valuations and with Dr Hatfield Dodds he is working on ways of valuing the impacts of climate change. Professor Curtis is involved in the work of two Cooperative Research Centres (CRC for Irrigation Futures and Dryland Salinity) and is engaged in collaborations with CSIRO scientists working on the Water for a Healthy Country Flagship. As a result of his CRC engagement, Professor Curtis was invited to contribute to a multi-authored synthesis of the literature on adoption of conservation practices by Australia's leading social and economic researchers, including Professors Pannell and Vanclay.

Professor Allan Lindsay Curtis

Best four publications 2001-2006

1. **Curtis, A.**, Byron, I., MacKay, J. (2005) Integrating socio-economic and biophysical data to underpin collaborative watershed management. *Journal of the American Water Resources Association* 41 (3):549-563.
Journal Impact Factor, 0.891. Scopus 1.
2. **Curtis, A.**, Byron, I., and McDonald, S. (2003) Integrating spatially referenced social and biophysical data to explore landholder responses to dryland salinity in Australia. *Journal of Environmental Management*, 68 (4): 397-407.
Journal Impact Factor, 1.163. Citations, ISI 1, Scopus 1.
3. **Curtis, A.**, Shindler, B., Wright, A. (2002) Sustaining local watershed initiatives: lessons from Landcare and Watershed Councils. *Journal of the American Water Resources Association* 38(5): 1207-1216.
Journal Impact Factor, 0.891. Citations, ISI 2, Scopus 2.
4. **Curtis, A.**, De Lacy, T. (2001) Landcare in Australia: does it make a difference, **in** Morris, J., Bailey, A., Turner, R.K., Bateman, I.J. (eds). *Managing the environment for sustainable development: rural planning and management*. pp.605-623. Edward Elgar, London. This book chapter was selected by the editors from papers published across the journals published by Edward Elgar. The original paper was published in *Environmental Management*.
Journal Impact Factor, 0.911, Citations, ISI 16, Scopus 28.

The four publications listed derive from two of the major research foci of teams that I have led at CSU since 1992: sustaining local organisations; and using social research to underpin watershed management. An impact factor above 0.6 indicates higher quality amongst journal publishing aspects of society and natural resource management/ agriculture. The three journals listed have impact factors greater than 0.8 and the *Journal of Environmental Management* has an impact factor of 1.163 and is widely regarded as the highest quality journal in the multidisciplinary environmental management field.

Sustaining local organisations: Landcare research

Drawing on theory of program evaluation, rural development, and extension, the research synthesised in paper #3 has been at the forefront of international efforts to assess and sustain the contribution of local organisations to natural resource management. Paper #4 has been widely cited by academic researchers and government/ agency staff and is the seminal paper establishing a framework for the evaluation of Landcare. My research exploring Landcare is the largest (25 peer-reviewed journal papers and 6 book chapters since 1995) and most comprehensive body of work on these organisations in Australia and of similar organisations in any developed economy. This research has explored program logic and effectiveness; participation as volunteer activity; agency-community partnerships; factors affecting group effectiveness; women's participation and experience; the role of networks in building social capital; and burnout amongst participants and coordinators. There have been studies in all Australian states and in Oregon and Montana in the USA, and paper # 3 includes comparisons of findings from collaborative research with Professor Bruce Shindler, Oregon State University.

The Landcare-related research has resulted in substantial advances in knowledge. For example:

- Contrary to existing literature, there was not a significant relationship between measures of landholder stewardship ethic and adoption of conservation behaviours.
- Using measures of group activity per year and participant's perceptions of longer-term outcomes contributed to increased understanding of factors contributing to organisational outcomes and to ways of monitoring Landcare group health.
- Survey work and participant observation of groups established that roles in Landcare were structured by gender.
- Piloting and then applying burnout scales (the MBI) in the Australian NRM context established that burnout was affecting Landcare group leaders and coordinators.

The research published in paper #4 (a book chapter based on an earlier paper of the same title in J) included the only state-wide longitudinal study of the health of Landcare groups in Australia. Regular surveys have been conducted between 1992 and 2004. Invited peer-review articles have been published as book chapters by 1) Edward Elgar (refer to paper # 4), 2) Land and Water Australia, and 3) the World Soil Conservation Association (In Press); and as a workshop paper by 4) the OECD.

2. **Curtis, A.** (2003) The Landcare experience, **in** Dovers, S., Wild River, S. (eds) *Managing Australia's Environment*. pp. 442-460. The Federation Press, Canberra.
3. **Curtis, A.** (2002) Landcare in Australia: facilitating dialogue and action, **in** *Proceedings of OECD Co-operative Research Program Workshop on: An interdisciplinary dialogue, Agricultural production and integrated ecosystem management of soil and water*. pp 186-204. November 12-16, Ballina, Australia.
4. **Curtis, A.** (In Press) Monitoring and evaluation of watershed initiatives: the experience with Landcare in Australia. **in** J. de Graaff, J., Pieri, C., Sombatpanit, S., and J. Cameron. (eds) *Monitoring and evaluation of soil conservation and watershed development projects*.

Research findings and my evaluation methodology have contributed to major national reviews, including the Australian Government's National Landcare Program (NLP). The NLP is a substantial (\$30 million per year) national program. For example, my research underpinned the evaluation framework and was extensively cited in the 2003 evaluation of the Decade of Landcare Plan (refer to Commonwealth of Australia. Report of the review of the National Landcare Program. Department of Agriculture, Fisheries and Forestry, Canberra). The evaluation methodology developed through my research also formed the basis of the \$1.5 million 2004/2007 Monitoring and Evaluation Project for the National Landcare Program (NLP) implemented by the Bureau of Rural Sciences and the Australian Bureau of Agricultural and Resource Economics.

Social research to underpin watershed management

A second research foci has explored ways that social research can underpin watershed management (refer to paper #1 & #2). This work has moved beyond the typical use of census data that has limited relevance to watershed managers, to collect spatially referenced data from the private landholders who manage most rural areas. Drawing on a range of theories, including adoption of agricultural and conservation practices, this research has provided insight into the values landholders attach to their properties, their adoption of recommended practices, and their long-term plans. Papers #1 and #2 have not been cited by many academics. In part, this may be attributed to the recent publication of #1 (late 2005) and the relatively narrow field that this research applies to.

Large sample surveys (1,000 plus landholders per watershed) are used to gather spatially referenced data that address Catchment Management Authority (CMA) needs for information to support effective landholder engagement, program development and evaluation of State and Australian Government investment through programs such as the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality. Working with regional partners (CMA) I've consistently achieved mail survey response rates in excess of 60%. This research had a substantial impact on the quality of watershed planning and evaluation in the three Victorian regions where it was first implemented. Acknowledging this impact, the Australian Government provided \$1.5 million for projects to be undertaken through the Department of Agriculture Fisheries and Forestry to demonstrate the methodology in the other Australian states. With additional projects already completed in New South Wales and Queensland, I now have a nationally significant data base.

Data collection has addressed important theoretical issues and contributed to important new knowledge and advances in methodology. For example, findings published in paper #2 established that most landholders are aware of the current extent of dryland salinity. This finding contradicted most previously published research suggesting that landholders were either unaware or would not publicly acknowledge the existence of insidious forms of land and water degradation.

The rare combination of spatially referenced social and biophysical data using a Geographic Information System (GIS) has provided ground breaking examples of social research capacity to model future trends. For example, the future intentions of landholders (dispose, increase holdings, family succession) were explored in the mail surveys. Using survey data and Australian Bureau of Statistics Life Expectancy Tables, it was possible for the first time to model future landholder turnover across a region. These data suggests that up to 50% of rural properties will change hands in the next decade across most Australian regions. This is an unprecedented level of change in managers and probably in property management, with important policy implications.

Other work has used survey data about landholder responses to incentives to take up revegetation work to model the achievement of CMA targets for biodiversity conservation and salinity mitigation. Apart from papers #1 & 2, these findings have been published in 1) a paper co-authored with Australia's leading socio-economic natural resource management researchers that synthesises the literature on the adoption of conservation practices by rural landholders; 2) a paper challenging existing literature and government policy that assumes farm forestry will be a preferred land use in high rainfall areas; and 3/4) papers providing an overview of the methodology and its application to the Australian context.

1. Pannell, D.J., Marshall, G.R., Barr, N., **Curtis, A.**, Vanclay, F., and Wilkinson, R. (In Press) Understanding and promoting adoption of conservation technologies by rural landholders. *Australasian Journal of Experimental Agriculture*.
2. Race, D., and **Curtis, A.** (In Press) Adoption of farm forestry in Victoria: linking policy with practice. *Australasian Journal of Environmental Management*.
3. **Curtis, A.**, MacKay, J., McDonald, S. (2002) Using spatial data to explore landholder awareness and concern about dryland salinity. *Australian Geographer* 33(2):159-170.
4. Lockwood, M., Hawkes, M., **Curtis, A.** (2002) Potential of revegetation incentives to meet biodiversity and salinity objectives: a study from the Goulburn Broken Catchment. *Australian Journal of Environmental Management* 9: 79-88.

Associate Professor Ian Gray

Best four publications 2001-2006

1. **Gray, I.**, and Lawrence, G. (2001) *A Future for Regional Australia: Escaping Global Misfortune*, Cambridge University Press, Cambridge.
2. **Gray, I.**, and Sinclair, P. (2005) Local Leaders in a Global Setting: Dependency and Resistance in Regional New South Wales and Newfoundland, *Sociologia Ruralis*, 45 (1/2):37-52.
Journal Impact Factor, 1.34. Citations 0.
3. **Gray, I.**, Williams, R. and Phillips, E. (2005) Rural community and leadership in the management of natural resources: tensions between theory and policy, *Journal of Environmental Policy and Planning*, 7 (2): 125-139.
Not referenced by journal impact factor companies.
4. **Gray, I.** (2005) Challenges to Individual and Collective Action **in** Cocklin, C. and Dibden, J., (eds) *Sustainability and Change in Rural Australia*, UNSW Press, Sydney.

Regional governance and 'bottom-up institutionalization

Since the publication of the book (publication #1), governance and the debates surrounding 'bottom-up' institutionalisation have become my main research field, particularly as they might be applied in regional situations. Three of the four publications listed are products of collaborations with Australia's leading social researchers, including Professors Geoff Lawrence (University of Queensland) and Chris Cocklin (Monash University) and with Professor Sinclair in Canada.

Publication #2 is in a high quality journal with an impact factor > 1 (too early yet for citations) and drew on research funded through the Australian Research Council and the Australian Social Sciences Academy that involved collaboration between six universities led by Prof Chris Cocklin. Publication #3 was also funded by the Australian Research Council.

The concluding argument in publication #1 made a case for greater attention to governance and regionalism as bases for regional policy. One examples of the impact of this publication is that I was subsequently invited to present to a conference in Queensland, for which developed a collaboration with Professor AJ Brown of Griffith University, which led to the recently announced ARC Discovery Grant 'Towards Sustainable Regional Institutions: The Nature, Role and Governance Implications of Contemporary Australian Regionalism'.

The body of work represented by the four publications listed above has resulted in a number of invitations to present to international research for a. For example, in October this year I have been invited to the University of York (UK) to do a presentation on work cultures with Dr Tim Strangleman of London Metropolitan University. Professor Julian Hine of the University of Ulster has invited me to collaborate with him on the broad topic of whether devolving or at least decentralising transportation management to regional institutions will enhance sustainability.

Associate Professor Mark Morrison

Best four publications 2001-2006

1. Morrison, M.D., Bennett, J.W. and Blamey, R.K. and Louviere, J.J. (2002). Choice Modelling and Tests of Benefit Transfer. *American Journal of Agricultural Economics*. 84(1): 161-170.
Journal Impact Factor, 0.967. Citations, Scopus 10.
2. Morrison, M. and Bennett, J. Valuing NSW Rivers Using Choice Modelling for Use in Benefit Transfer (2004). *Australian Journal of Agricultural and Resource Economics*. 48(1): 591-612.
Journal Impact Factor, 0.867. Citations, Scopus 1.
3. Mallawaarachchi, T., Blamey, R.K., Morrison, M., Johnson, A. and Bennett, J. (2001). Community values for environmental protection in a cane farming catchment in Northern Australia: A Choice Modelling Study, *Journal of Environmental Management*. 62: 301-316.
Journal Impact Factor, 1.163. Citations, ISI 2.
4. Mallawaarachchi, T., Morrison, M.D. and Blamey, R.K., (2006) Valuing Land Use Changes Using Choice Modelling. *Land Use Policy*. 23(3): 323-332. Journal Impact Factor, 1.035. Citations N/A.

My principal research foci are in the areas of environmental economics and marketing. Within environmental economics, I research in the areas of non-market valuation (which involves the valuation of intangibles), market based instruments (market especially program design and issues related to participation) and technology adoption. In marketing, I research in the area of consumer behaviour, market segmentation and new product development. The areas I research in environmental economics and marketing are linked. Many of the research methods (e.g. conjoint analysis) used for non-market valuation in economics are also used in new product development for marketing. Similarly, many of the concepts for technology adoption in economics are also used for new product development in marketing. The methodology used for market segmentation in marketing also has application to the design of market based instruments. Thus, while my research covers two discipline areas, I have sought to integrate my research wherever possible.

Environmental economics and marketing.

Paper #1 published findings from the first study to demonstrate the advantages of using choice modelling for benefit transfer. Benefit transfer is the extrapolation of environmental valuation estimates from an original study site to a second site. Choice modelling is a multi-attribute technique that can be used for non-market valuation, such as determining the value of improved environmental quality. It is a multi-attribute technique as it produces estimates of the value of environmental attributes (e.g. extra waterbird species, additional hectares of land preserved). It is this ability to produce value estimates at the attribute level that makes it uniquely suitable for benefit transfer. Prior to this study, virtually all benefit transfer studies involving non-use values (e.g. estimating existence or bequest values) relied on the contingent valuation method. In a contingent valuation study values are not derived for attributes; rather a total value for a change in environmental quality – which is equivalent to a

change in a bundle of attributes – is estimated. This total value cannot be readily modified when extrapolated to different site, even if the change in environmental quality at the second site is markedly different. Hence, not surprisingly, virtually all tests of the validity of using contingent valuation for benefit transfer have produced negative findings.

Since paper #1 was published, the use of choice modelling for benefit transfer has become the industry norm. Thus this study has led to a large shift in practice within the discipline. Another 12 published studies have followed this seminal study (with almost all citing it), in order to assess the generalisability of its findings (Morrison and Bergland, forthcoming). A further four studies using the approach recommended in this study are currently being conducted internationally in the US, UK, Germany and Australia. The quality of this article is supported by several facts. First, it is published by the world's leading agricultural economics journal. This journal has a high impact factor (0.967). Its usefulness to other practitioners is indicated by the high rate of citation (10 Scopus citations). And finally, this research was funded through a national competitive grant from Land and Water Australia, with partner contributions from NSW National Parks and Wildlife Service and NSW Environment Protection Authority.

Paper #2 presented findings from seven choice modelling studies designed to enable the non-market valuation of all rivers in NSW as part of the water reform process in NSW. The study was commissioned and funded by the NSW government (Environment Protection Authority) and Land and Water Australia (via a competitive grant). This research has made three important contributions to the discipline:

- It demonstrated how to systematically apply benefit transfer on a large scale when separate value estimates are needed for respondents residing within and outside of catchments. This was achieved by valuing five separate and representative catchments within NSW. The values estimated for each of these catchments could then be transferred to similar catchments elsewhere in the state.
- Second, the study demonstrated the use of a pooled benefit transfer model to generate benefit transfer estimates where there were gaps in the experimental design. Given budget limitations, separate choice modelling studies were conducted only for respondents within each of the five catchments, and two choice modelling studies were conducted to estimate values held by respondents residing outside of two of these five catchments. To estimate the values held by respondents residing outside of these other three catchments the pooled model was estimated. This was the first time in the literature that this approach has been used (Morrison and Bergland, forthcoming).
- Third, because of the large number of separate choice modelling applications, this study was able to contribute to the literature demonstrating the validity of using choice modelling for benefit transfer. The results demonstrated that the use of choice modelling for benefit transfer is not valid in all circumstances, but rather depends on the similarity of sites and populations.

The quality of the research published in paper #2 can be demonstrated in several ways.

- The study has been published in a journal with a high impact factor (0.867). While it has yet to produce a large number of citations due to its recent publication, its usefulness to other practitioners can be gauged by the fact that Australian Journal of Agricultural and Resource Economics statistics indicate that it was the second most downloaded article of all articles published in this journal in 2004 (amongst all four volumes).

- The results from this study have been used by the NSW government in cost benefit analysis as part of the water reform process. The Victorian government also transferred the values generated in this study for their cost-benefit analyses of riverine issues.

Findings published in paper #3 demonstrated the value of preserving wetlands from sugar cane farming. This was the first research applying choice modelling to be published in the *Journal of Environmental Management*, which is the leading environmental management journal with an impact factor of 1.163. The results from this study have been applied to other research, with the values generated in this study being incorporated into a linear programming model identifying optimal management strategies for the sugar cane industry (Mallawaraachi and Quiggin 2004).

Paper #4 demonstrated the usefulness of choice modelling for land use management decisions. The research findings demonstrated the relative value of preserving land for native vegetation compared to using the area for sugar cane or urban development. As the study has only recently been published there have been limited citations. Nonetheless its quality is attested by its publication in the world's leading land use planning journal which has an impact factor of 1.035.

Professor Eddie Oczkowski

Best four publications 2001-2006

1. Oczkowski, E., (2001) Hedonic Wine Price Functions and Measurement Error. *Economic Record*, **77** (239), 374-382. Journal Impact Factor, 0.286. Citations, ISI 4, Scopus 7.
2. Oczkowski, E., (2002) Discriminating Between Measurement Scales using Non-nested Tests and 2SLS: Monte Carlo Evidence. *Structural Equation Modeling*, **9** (1), 103-125. Journal Impact Factor, 1.583. Citations, ISI 3, Scopus 0.
3. Oczkowski, E., (2006) Modelling Winegrape Prices in Disequilibrium. *Agricultural Economics*, **34** (1), 97-107. Journal Impact Factor, 0.534. Citations, ISI 1, Scopus 0.
4. Oczkowski, E., (2006) Nash Bargaining and Co-operatives. *Australian Economic Papers*, **45** (2), 89-98. Journal not listed for impact factors. No Citations.

Developing and applying statistical techniques to analyse agricultural markets

In part, the sustainability of regional communities relies on the on-going viable production of agricultural commodities. An understanding of the operation of markets is an important part of the information set which farmers use to match production plans with appropriate market signals. The focus of my research is the development and application of statistical techniques to analyse agricultural markets. I have analysed markets relating to the following agricultural commodities: tobacco leaf, rice, table wine, wool, eggs and wine grapes. Techniques have been developed that recognise disequilibrium trading in agricultural markets, how bilateral monopoly markets trade and the imprecise measurement of attributes in hedonic market price functions. Part of this focus also relates to how agricultural co-operatives may trade in bilateral monopoly markets with large food processors.

The statistical tools I have developed to recognise the imprecise measurement of attributes in hedonic price functions are also applicable for comparing models which use alternative measurement scales. The techniques have wide application in disciplines such as: economics, marketing, management, education, psychology and sociology.

Evidence to support the quality of the four publications listed focuses upon ISI journal impact factors, the prestige of those journals and article citation rates. Given the annual variability in impact factors, I have also provided average and the most recent impact factors and refer to other journal rankings. When considering ISI ratings it is important to note the depth of coverage of economics publications in ISI. For example, in 2005 the ISI covered 175 journals in the economics category. EconLit is the principal electronic database for economics journals and provides abstracts for over 620 journal titles. Assuming ISI covers the best journals in the discipline then it can be assumed that any of the economics journal listed in ISI is in the top 30% of journals in the discipline.

The research approach presented in paper #1 is part of a developing literature on hedonic wine pricing started by my publication in the *Australian Journal of Agricultural Economics* (ISI cites 16) and has been recognised by researchers examining other features of the Australian market: bulk wine, the value of expert opinion and values of icon wines. In paper #1 I explored measurement error in hedonic market price functions in a study of Australian table wine using various indicators for the quality and reputation of wines. This research made important contributions to technique development and illustrated the application of the technique. The *Journal of the Economic Society of Australia* is the highest ranked Australian economics journal, and is ranked 58 out of 159 journals in the European Economic Association study (2003). The paper has been cited by researchers in France, the United States and Germany.

The research published in paper #2 represented further development and assessment of the statistical properties of techniques for discriminating between statistical models which use competing measurement scales. The techniques are broadly applicable to various disciplines where measurement scales are used in developing models. The technique has been applied to Australian wine and measures of quality and reputation in publication #1 and my other research on enterprise training, and the marketing and learning orientation of firms. *Structural Equation Modeling* has a high citation index of 1.583 and is ranked 7 of 32 journals addressing Social Sciences Mathematical Methods. The citations of this article relate to areas such as: sociology and communication. Publication #2 assesses and further develops techniques introduced by my publication in the *International Journal of Marketing Research* (ISI cites 10).

Research published in paper #3 extends the hedonic price approach to disequilibrium markets. Traditionally hedonic price functions assume that markets trade in equilibrium. This paper established that given the existence of contractual arrangements, supply fixity and market concentration, demand may not equal supply and that hedonic prices may be the outcome of a disequilibrium price adjustment process. The notion and method is applicable to any market which faces similar market circumstances. The novel application of this principle is to wine-grapes in Australia. The model develops estimates of price premiums/discounts for wine varieties and regions. This provides important information for vineyard planning and wine production strategies and hence potentially enhances the viability of regional communities in traditional wine growing districts. Established in 1986, *Agricultural Economics* is the journal of the International Association of Agricultural Economists. The acceptance rate is 25% and the journal is ranked 130 out of 175 Economics journals.

Paper #4 is part of a larger body of work on agricultural co-operatives that explores how cooperatives may operate in markets to countervail the market power of large food processors. This article develops the appropriate economic theory to explain how an agricultural co-operative may interact with a large food processor in a bilateral monopoly market situation. The theory assesses various strategies the co-operative may follow and makes recommendations. The paper makes a contribution to economic theoretical literature dating back to the 1960s. The analysed circumstance is potentially important for the dairy, sugar, wine-grape and chicken meat sectors. The research adds to the important current debate about changes to the Trade Practices Act and collective bargaining. The paper was the lead article in its issue. *Australian Economic Papers* publishes innovative and thought provoking contributions which extend the frontiers of the subject, written by leading international economists in theoretical, empirical and policy economics. The journal is published by Blackwell and has an Editorial Board with members from five countries.

Professor Kevin A. Parton

Best four publications 2001-2006

1. Bi, P. and Parton, K.A. (2002), El Nino and incidence of hemorrhagic fever with renal syndrome in China, *Journal of the American Medical Association* 289 (2), 176-177.
Journal Impact Factor, 23.332. Citations 0.
2. Bi, P. and Parton, K.A. (2003), Climate variations and the transmission of Ross River virus infection in coastal and inland regions of Queensland--an analysis from Townsville and Toowoomba, *Environmental Health* 3 (4), 73-79.
Journal Impact Factor. Citations 0.
3. McCown, R.L., Brennan, L.E. and Parton, K.A. (2006), A century of learning to make Farm Management research and intervention relevant to farm management practice: 1. The rise and demise of intervention using theoretical models. *Australian Journal of Agricultural Research* 57, 143-156.
Journal Impact Factor, 0.993. Citations 0.
4. McCown, R.L. and Parton, K.A. (2006), A century of learning to make Farm Management research and intervention relevant to farm management practice: 2. Systems approaches. *Australian Journal of Agricultural Research* 57, 157-72.
Journal Impact Factor, 0.993. Citations, ISI 1.

I am an agricultural economist/health economist and my research explores topics related to climate, the environment, disease and decision making. This work is by its nature cross-disciplinary and I've undertaken projects in China and the Philippines as well as Australia.

Risk in the context of health and agricultural decision making

Publications #1 and #2 are related to the project El Nino Southern Oscillation and vector-borne diseases in Australia. In fact, publication #1 was conducted in China and is a precursor to the work in Australia which is now the prime focus of the project. The basis for this Chinese work was an even earlier investigation into the impact of weather on meningitis epidemics in central Africa. The contribution of these two publications is to show that in certain locations there is a lag of several months between weather events or weather indices like the SOI and health impacts of various vector-borne diseases. Such relationships might be expected because Australia is located in the central region of the Pacific, where much of the year-to-year variation in temperature and rainfall is related to the El Nino Southern Oscillation (ENSO).

Publications #1 and #2 are part of a larger body of research that includes:

- Secular trends in mortality rates for diabetes in Australia with Dr Bi Peng, University of Adelaide.

This research is characterising long-term mortality trends for diabetes in Australia during the 20th century, and providing suggestions to health policy-makers. It shows the influence of insulin, diet, obesity, and various lifestyle factors on the disease prevalence in different groups of the population.

- El Nino Southern Oscillation and vector-borne diseases in Australia with Dr Bi Peng, University of Adelaide.

Australia is located in the central region of the Pacific, where much of the year-to-year variation in temperature and rainfall is related to the ENSO. This makes the country ideal for the investigation of the relationship between climate and vector-borne diseases, mainly dengue fever, Barmah forest virus infection and Ross River virus infection—several important vector-borne diseases in Australia. Our findings indicate that in particular locations there is a strong seasonal influence for each disease. This is useful in predicting the likelihood of the need for health resources.

- Integrating assessment of the effect of climate change for Australian rural and remote regions with Dr Bi Peng, University of Adelaide.

This research is attempting to assess the impact of likely future climate change on three communities by integrating the various crop, livestock, economic, social and human health impacts.

- Bridging the gaps between seasonal climate forecasts and decision makers with Dr P. Hayman, SARDI, Dr J. Mullen, NSW DPI and Mr J. Crean, University of Sydney.

Rainfed agriculture in the Philippines and eastern Australia is greatly affected by the ENSO. This research has five objectives, but my contribution has concentrated on two of these: to develop an analysis that assists Philippine decision makers better predict the rice harvest using seasonal climate forecasts (SCFs); and to analyse farm decision making in Australia using SCFs.

- Examining the conditions necessary to make seasonal climate forecasts valuable with Dr P. Hayman, SARDI, Dr J. Mullen, NSW DPI and Mr J. Crean, University of Sydney.

The value of seasonal climate forecasts (SCFs) has been a topic of considerable research that has resulted in a range of conclusions. Our team has reviewed this literature and established that various unspecified assumptions have been made in different research and that these assumptions are crucial to the valuation findings. This suggests that there are a series of significant parameters of a decision situation that should be laid-bare and are worthy of investigation before values can be attached to SCFs.

Publications #3 and #4 are seminal papers (with Dr R L McCown, CSIRO) in the discipline of farm management and are derived from a historical examination of scientific best practice in Farm Management in the USA and in Australia. Our analysis demonstrated that there have been dramatic failures of all the schools of farm management as an academic discipline. The way forward from this impasse is to offer farmers the best virtual analysis of their individual farm problems, and experiment in a team with them to analyse the farm management problem effectively and at the same time, develop their expectations about the capabilities of their property.

Research Grouping # 2

Ecology and Biodiversity Group Evidence Portfolio

Context statement

The Ecology and Biodiversity Group of the ILWS comprises 15 members (4 early-career and 11 principal members) and 33 associate members, including 18 PhD students. We are a diverse and dynamic group united by our common research interests in ecology and biodiversity conservation. This application is based on six Principal Researchers with demonstrated capacity to attract nationally competitive grants and with internationally recognised research programs centered on large-scale ecosystem processes: **Dr Paul Humphries, Dr Gary Luck, Dr Ian Lunt, Professor Nicholas Klomp, Dr David Watson and Dr Robyn Watts.**

Drawing on the disciplines of biogeography, limnology, community and landscape ecology, our research examines the mechanisms underlying large-scale spatial and temporal patterns in ecosystem processes and species distributions, with particular emphasis on degraded aquatic and terrestrial ecosystems in agricultural regions. We focus on human development as a key driver of ecosystem change, allowing us to develop practical and effective management strategies to restore degraded ecosystems and conserve biological diversity while accommodating socio-economic development.

In practical terms, our research provides insights into two pivotal questions for sustainable land management:

1. How can biodiversity best be conserved in highly modified agricultural landscapes?
2. What are the most effective techniques for managing and restoring our degraded waterways and terrestrial ecosystems?

Our research is primarily conducted throughout the Murray-Darling Basin. However we are contributing to important national and international collaborations, with particularly strong links to research groups in Europe and North America.

Our group's research is directly relevant to two research goals within National Research Priority 1: *An Environmentally Sustainable Australia*: (1) *Water – a critical resource*, and (2) *Sustainable use of Australia's biodiversity*. While virtually all of our work is concerned with '*sustainable use of Australia's biodiversity*', our aquatic research is also directly relevant to '*water – a critical resource*', as evidenced by Humphries' and Watts' important studies on the effects of river flow manipulations on ecological processes and species conservation.

The group has achieved considerable success in research income, prestigious national and international publications, and post-graduate and honours completions.

Research Income

Collectively the six members have obtained \$9.2 million research income during their careers, including \$4.5 million at CSU, and \$3.2 million at CSU in the past five years (Table 1). This income includes a large number of nationally competitive research grants, including grants from the Australian Research Council Discovery and Linkage (SPIRT) programs, Land and Water Australia, Rural Industries Research and Development Corporation and the Murray–Darling Basin Commission (see Part D for list of nationally competitive grants received since 2000). Since 2001 we have received eight ARC grants, including four Discovery and four Linkage grants.

Table 1. Research income from six members of Ecology & Biodiversity Group

Income	Humphries	Klomp	Luck	Lunt	Watson	Watts	Total
Career total	4,565,600	1,214,000	286,000	1,295,200	600,000	1,252,100	9,212,900
CSU total	198,600	1,214,000	131,000	1,194,900	560,000	1,211,600	4,510,100
CSU last 5 yrs	198,600	507,100	131,000	1,036,300	539,000	837,600	3,248,600

Note: Dr Paul Humphries joined CSU in 2005, and Gary Luck in 2003, which accounts for their relatively low contribution to CSU's research income.

Research Publications

Our research income is equally matched by strong publication records. During our research careers, we have produced 210 peer-reviewed (refereed) publications, including 91 refereed publications in the last 5 years (Table 2). Highlights from this extensive publication record are listed in Part C.

Table 2. Total number of peer-reviewed publications by applicant

	Humphries	Klomp	Luck	Lunt	Watson	Watts	Total
Career total	30	54	26	49	28	25	210
Last 5 years	7	8	22	21	19	15	91

Our best papers have been published in the world's leading journals, including two papers in the prestigious journal *Nature* (ISI 32.2; papers by Klomp and Luck), and four more papers in journals with some of the highest impact factors in our discipline, including *Trends in Ecology and Evolution* (ISI 12.9; Luck), *Proceedings of the National Academy of Sciences* (ISI 10.5; 2 papers by Luck) and *Annual Review of Ecology and Systematics* (ISI 9.429; Watson).

Moreover, our best papers have been repeatedly cited in the scientific literature, with up to 65 citations for a paper by Watts (Table 3). By comparison, the average citation rate for ecology and environmental papers by Australian researchers is 3.4 (data from Thomson ISI, quoted in the Australian Higher Ed. Supplement, 24 March 2004). Thus all members of our group continue to produce high quality papers, far in excess of industry averages. Given that many of our best publications were published in the last few years (Part C), we confidently expect that our citation rates will continue to grow in the future.

Table 3. Maximum journal impact factor and number of citations for refereed publications by each member of our team

	Humphries	Klomp	Luck	Lunt	Watson	Watts
Max. journal impact factor	2.899	<u>32.182</u>	<u>32.182</u>	3.266	9.429	1.772
Max. citations per paper	35	26	51	25	24	<u>65</u>

Dr Paul Humphries

The main thrust of my research involves understanding the role of flow in influencing the diversity, habitat use, life history, diet, movement and population dynamics of the biota of rivers. This work aims to understand the impact that regulation has had on lowland rivers throughout the world and to contribute to the restoration of these degraded ecosystems.

I moved to CSU from the Murray-Darling Freshwater Research Centre in October 2004. My recent research projects have been funded by competitive grants from the Murray-Darling Basin Commission, Environment Australia, LWRRDC, AFFA, CRC for Freshwater Ecology and the National Landcare Program.

1. **Humphries, P.**, Cook, R.A., Richardson, A.M. & Serafini, L.G. (2006). Creating a disturbance: manipulating slackwaters in a lowland river. *River Research and Applications*. 22: 525-542
ISI 1.426, Citations 0.

In one of the few field experiments of its kind, we showed conclusively what researchers had been hypothesising for years; that increases in flow because of irrigation releases caused rearing habitats to be flushed out and the juveniles inhabiting them, displaced. These results have major significance for the sustainability of fish populations in lowland rivers and will, without doubt, influence the management of lowland rivers in the future.

2. **Humphries, P.** & Baldwin, D.S. (2003). Drought and aquatic ecosystems: An introduction. *Freshwater Biology* **48**, 1141-1146.
ISI 2.205, Citations 16.

This paper was an introduction to a special issue of the international journal *Freshwater Biology*, on 'The role of drought in the ecology of aquatic systems', which I co-edited. We brought together about 90 participants from around the world to discuss this important topic. The special issue has put drought on the agenda, not as an inherently destructive event, but one as integral to functioning river systems as floods.

3. **Humphries, P.**, Serafini, L.G. and King, A.J. (2002). River regulation and fish larvae: changes in space and time. *Freshwater Biology* **47**: 1307-1331
ISI 2.205, Citations 19.

This study investigated patterns in composition and abundance of fish larvae – and, thus, spawning – in a heavily regulated river, showing for the first time which species of fish had self-sustaining populations. The results are quite staggering: that of the 18-20 native species that once lived and bred in this lowland river, now only three species do. The fauna is dominated by opportunistic natives and alien species. We suggest, for the first time, how flow alteration may have resulted in degradation of lowland river fish faunas. The use of fish larvae in assessing river health, as a result of this and earlier work, is now being adopted widely throughout Australian freshwater systems.

4. King, A.J., **Humphries, P.** & Lake, P.S. (2003). Use of floodplain environments during high and low flow conditions by larval and juvenile fish. *Canadian Journal of Fisheries and Aquatic Sciences* **69**, 773-786.
ISI 1.972, Citations 9.

In the first rigorous study of fish on inundated floodplains in the Murray-Darling Basin, we showed that only introduced carp bred on inundated floodplains. We developed a model of floodplain usage by fish, which showed that floodplain breeding does not make ecological sense for many species. This work has been adopted by river managers, especially for carp control, and the conceptual model has been used internationally.

Klomp, Professor Nicholas

Professor Klomp studies how the behavioural ecology of animals influences their abundance and distribution within landscapes. His current and recent work focuses on the conservation and management of vertebrates, especially birds, and the broadscale ecological processes that determine their population dynamics. His recent research projects have been funded by competitive grants from ARC Linkage and RIRDC, plus support from the NSW National Parks & Wildlife Service.

1. Green, D.G., **Klomp, N.I.**, Rimmington, G. & Sadedin, S. (2006). *Complexity in Landscape Ecology*. Springer, Dordrecht.

This 208-page book presents a new perspective on traditional ecology. We employed recent advances in modelling, artificial life and complexity theory to provide new insights into patterns and processes in landscapes and ecosystems. The text uses new and existing data to integrate disparate disciplines to better understand and manage complex landscapes.

2. [Voltier, S.C.](#), [Furness, R.W.](#), [Bearhop, S.](#), [Crane, J.E.](#), [Caldow, R.W.G.](#), [Catry, P.](#), [Ensor, K.](#), [Hamer, K.C.](#), [Hudson, A.V.](#), [Kalmbach, E.](#), **[Klomp, N.I.](#)**, [Pfeiffer, S.](#), [Phillips, R.A.](#), [Prieto, I.](#), [Thompson, D.R.](#) (2004). Changes in fisheries discard rates and seabird communities. *Nature* **427**, 72-730.
ISI 32.182, Citations, 13.

Published in one of the world's most influential journals, our paper presented the results of a long-term, multinational study to dramatically illustrate how current fisheries and management policies adversely affect bird communities. The study has been cited as a classic example of the complex interactions within ecosystems, and illustrates how ill-informed policies or practices can have significant effects on the natural environment.

3. Ratcliffe, N., Catry, P., Hamer, K.C., Furness, R.W. & **Klomp, N.I.** (2002). The effect of age and year on the survival of adult breeding Great Skuas *Catharacta skua* in Shetland. *Ibis* **144**, 384-392.
ISI 1.206, Citations, 7.

Published in one of the world's leading ornithology journals, this paper is another example of the extent of my international collaborations, here with British and Spanish researchers. This paper provided data and new explanations of the factors that influence survival of long-lived animals.

4. Weerheim, M.S, Klomp, N.I., Brunsting, A.M.H. & Komdeur, J. (2003). Population size, breeding habitat and nest-site distribution of little penguins (*Eudyptula minor*) on Montague Island, New South Wales. *Wildlife Research* **30**: 151-157.
ISI 0.993, Citations, 0.

This study documents the habitat factors affecting the population of penguins on Montague Island—one of the world's largest Little Penguin colonies, but previously poorly documented. This international collaboration between the CSU and staff and students from Wageningen University (Netherlands) examined the effects of current management practices on seabirds breeding on the island, drawing on historical and current data to establish the baseline and methodology against which all future studies can be compared.

Dr Gary Luck

My research examines the impact of human development on biodiversity conservation. I conduct applied research designed to develop conservation strategies for biodiversity in human-dominated landscapes from the local to the continental scales. In particular, I study the ecology and conservation of fauna in agricultural and urban landscapes, modifying human land use to improve outcomes for biodiversity, and documenting the services provided to humanity by ecosystems. I moved to CSU in 2003.

1. Liu, J., Daily, G.C., Ehrlich, P.R. & **Luck, G.W.** (2003). The effect of household dynamics on resource consumption and biodiversity. *Nature* **421**, 530-533. ISI 32.2, Citations, 51.

This landmark paper was the first to examine the global implications of household dynamics on biodiversity conservation. In the paper we demonstrated that growth in the number of households outstripped population growth owing to declining occupant numbers per household. This trend magnifies the threat humans pose to ecosystems.

2. **Luck, G.W.**, Daily, G.C. & Ehrlich, P.R. (2003). Population diversity and ecosystem services. *Trends in Ecology and Evolution* **18**, 331-336. ISI 12.9, Citations, 35.

This study introduced a new population classification, the service-providing unit, to link species populations with the services they provide to humanity. These units provide a more meaningful assessment of the implications of the biodiversity crisis for humans, than traditional approaches. The paper provided the framework for a newly funded (Euro 2M) international project (including CSU) to assess ecosystem services across Europe.

3. **Luck, G.W.**, Ricketts, T.H., Daily, G.C. & Imhoff, M. (2004). Alleviating spatial conflict between people and biodiversity. *Proceedings of the National Academy of Sciences of the United States of America* **101**, 182-186. ISI 10.5, Citations 14.

This groundbreaking study demonstrated the tight relationship between human populations and species richness in Australia and North America, and explored strategies for alleviating conflict between human development and biodiversity conservation.

4. Ricketts, T.H., Dinerstein, E., Boucher, T., Brooks, T.M., Butchart, S.H.M., Hoffmann, M., Lamoreux, J., Morrison, J., Parr, M., Pilgrim, J.D., Rodrigues, A.S.L., Sechrest, W., Wallace, G.E., Berlin, K., Bielby, J., Burgess, N., Church, D.R., Knox, D., Loucks, C., **Luck, G.W.**, Master, L., Naidoo, R., Ridgely, R., Schatz, G., Shire, G., Strand, H., Wettengel, W. & Wikramanayake, E. (2005). Pinpointing and preventing imminent extinctions. *Proceedings of the National Academy of Sciences of the United States of America* **102**, 18497-18501. ISI 10.5, Citations 3.

This paper represents a milestone in our understanding of the magnitude of the extinction crisis. We analysed an immense database to identify the location of 794 critically endangered species across the globe and provided guidelines to ensure their conservation. It is one of the

20 most read papers online at *PNAS* and underpins conservation efforts by the global Alliance for Zero Extinction (<http://www.zeroextinction.org/>).

Dr Ian Lunt

My research documents the effects of human disturbance regimes on vegetation patterns and ecosystem processes in fragmented agricultural landscapes. This work encompasses historical and disturbance ecology, community dynamics and, increasingly, restoration ecology. My research has led to practical techniques for conserving biodiversity in degraded, fragmented ecosystems. Recent research has been funded by nationally competitive grants from ARC Discovery, ARC Linkage and Land and Water Australia, plus grants from the NSW Environmental Trust.

1. **Lunt, I.D.** & Spooner, P.G. (2005). Special Paper: Using historical ecology to understand patterns of biodiversity in fragmented agricultural landscapes. *Journal of Biogeography* **32**(11), 1859-1873.
ISI 2.329, Citations, 1.

In this major review (tagged a 'special paper' in the journal), we developed a conceptual framework for understanding landscape patterns in fragmented agricultural landscapes. By emphasising the importance of temporal changes, our review illustrated how incorporation of historical attributes into landscape ecology studies can expand our understanding of the factors driving biotic patterns in fragmented agricultural landscapes.

2. **Lunt, I.D.**, Jones, N., Spooner, P.G. & Petrow, M. (2006). Effects of European colonization on indigenous ecosystems: post-settlement changes in tree stand structures in *Eucalyptus-Callitris* woodlands in central New South Wales, Australia. *Journal of Biogeography* **33**, 1102-1115.
ISI 2.329, Citations, 0.

In this study, we developed the first reliable, quantitative estimates from any region of Australia of regional tree stand structures at the time of European settlement. This information is needed to guide policies on vegetation clearance and to understand causes of salinity. Our findings have been eagerly sought by management agencies, and 1,200 copies of the pre-print have been downloaded from my web page in the past 8 months.

3. Prober, S. M., Thiele, K.R., **Lunt, I.D.** & Koen, T.B. (2005). Restoring ecological function in temperate grassy woodlands: manipulating soil nutrients, exotic annuals and native perennial grasses through carbon supplements and spring burns. *Journal of Applied Ecology* **42**, 1073-1085.
ISI 3.266, Citations 0.

In this ground-breaking study we demonstrated that degraded ecosystems can only be restored sustainably if altered ecosystem processes are also cured. By reducing available nutrient levels, we controlled weeds and successfully re-introduced dominant native plants in endangered woodlands. Directly relevant to on-ground restoration, the results have been reported in dozens of magazines and newsletters across Australia.

4. **Lunt, I.D.** (2002). Grazed, burnt and cleared: how ecologists have studied century-scale vegetation changes in Australia. *Australian Journal of Botany* **50**(4), 391-407.
ISI 1.209, Citations, 15.

Long-term vegetation changes are critically important to ecosystem ecology. This paper provides the first major review of how Australian ecologists have approached this issue. By analysing the methods used in earlier studies, I identified major research genres, poorly studied ecosystems and major methodological gaps. This important review is the 3rd most frequently downloaded paper from the journal (CSIRO Web Site, August 2006).

Dr David Watson

Why are there more species in some areas than others? This simple question drives my research program, emphasising determinants of diversity in fragmented landscapes. By combining community ecology and biogeography with autecology, and adopting both empirical and theoretical approaches, my research aims to reveal the mechanisms underlying patterns of biodiversity occurrence, identifying processes and prioritising management actions. Recent research has been funded by two nationally competitive ARC Discovery grants.

1. **Watson, D.M.** (2003). Long-term consequences of habitat fragmentation: highland birds in Oaxaca, Mexico. *Biological Conservation* **111**, 283–303.
ISI 2.166, Citations 5.

To understand the long-term effects of fragmentation, I studied birds in Mexican forests fragmented for 5000 years. Bird diversity was more affected by the size of patches than by their spatial isolation, which suggests that isolation effects in recently fragmented areas may disappear over time. One of few studies to document long-term fragmentation effects, this article has motivated research in southern Mexico, N.Z. and N. America.

2. **Watson, D.M.** (2002). A conceptual framework for the study of species composition in islands, fragments and other patchy habitats. *Journal of Biogeography* **29**: 823–34.
ISI 2.329, Citations, 14.

In this paper, I developed a classification system to explain diversity patterns in islands, fragmented habitats and inherently patchy ecosystems. Predictions about long-term fragmentation effects were then developed. This paper has attracted considerable attention internationally, including a paper based on “Watson’s framework” in 2005, and a 2006 review which used the framework as the basis for a broad comparative synthesis.

3. **Watson, D.M.** (2001) Mistletoe—a keystone resource in forests and woodlands worldwide. *Annual Review of Ecology and Systematics* **32**:219–49.
ISI 9.429, Citations, 22.

In this invited review, I synthesised interactions between mistletoes and animals worldwide, and developed the hypothesis that mistletoe functions as a keystone resource, promoting diversity in most habitats studied. This review has been widely cited internationally, attracting broad support for the keystone hypothesis, and underpins several ongoing research projects (including two ARC Discovery projects).

4. **Watson D.M.** (2005). Diagnosable versus distinct: evaluating species limits in birds. *BioScience* **55**, 60–68.
ISI 3.041, Citations 2.

In this paper, I examined how species limits assigned to birds compare with methods used in other groups. I suggested that the gap between evolutionarily distinct and operationally diagnosable forms is greater in birds than for many other groups, leading to many distinct forms of birds not being considered different species. The article elicited an invitation from *British Birds* to summarise the implications for European ornithology.

Dr Robyn Watts

My research examines the ecology, biodiversity, management and restoration of aquatic ecosystems, with recent research focusing on examining ecological responses to flow regimes in regulated rivers. My research findings have underpinned efforts by management agencies to set priorities for river restoration and with the development of new operational plans for dams to alter flow patterns and improve downstream river health. My research has been funded by nationally competitive grants from Land and Water Australia and ARC SPIRT, plus projects for the Murray-Darling Basin Commission and the NSW Water Management Fund.

1. **Watts, R.J.** & Johnson, M.S. (2004). Estuaries, lagoons and enclosed embayments: habitats that enhance population subdivision in inshore fishes. *Marine and Freshwater Research* **55**(7), 641-651.
ISI 0.955, Citations ISI 1.000

Publication #1 is one of a series of refereed journal papers I have published to address the question, 'how do environmental and biological factors affect biodiversity, dispersal and gene flow in aquatic environments?' I have examined the relationship between gene flow and speciation in a dispersive environment and have demonstrated that genetic structure can develop in the presence of high gene flow. For example, one of my papers (Watts *et al.* 1990 *Marine Biology* 105, 145-152, 65 citations) highlighted the circumstances under which genetic differences can develop between populations in aquatic ecosystems. In publication #1 my colleague and I analyzed published papers to examine patterns of population subdivision in inshore fishes. We found that estuarine populations may be genetically isolated from coastal populations and that estuaries provide special opportunities for genetic divergence. This has implications for managing inshore fish stocks, designing marine reserves and conserving coastal areas. From March to September 2006 this paper was listed as one of the top 20 most downloaded papers in the journal *Marine and Freshwater Research*.

2. **Watts, R.J.**, Nye E.R., Thompson, L.A., Ryder, D.S., Burns, A. & Lightfoot, K. (2005). *Environmental monitoring of the Mitta Mitta River associated with the major transfer of water resources from Dartmouth Reservoir to Hume Reservoir 2004/2005*. Report to the Murray Darling Basin Commission.

This research involved a large, field-based experiment where we demonstrated that increasing the variability of flows from Dartmouth Dam improved river health downstream. The impact of peer-reviewed report is best judged through its influence on river management. These findings have underpinned recent decisions to change river management practices and formed the basis of a release trial in March 2006. This has resulted in positive environmental outcomes without requiring an increase in the allocation of environmental water. This is an important finding at a time when there is competition for diminishing water resources and limited water that can be allocated specifically for environmental purposes.

3. Ryder D.S., **Watts R.J.**, Nye E., & Burns, A. (2006). Can flow velocity regulate epilithic biofilm structure in a regulated floodplain river? *Marine and Freshwater Research* **57**(1), 29-36.
ISI 0.955, Citations 0.

This ARC-funded research identified ecological indicators for assessing environmental flows and highlighted the effects of flow regime, specifically water velocity, on lowland river ecosystems. This research has improved agency understanding of river ecosystems. The findings from this study underpin recent trials to examine the effects of changed flow management on river ecosystems and have contributed to the development of new operational plans for dams. These changed management practices have had demonstrable environmental benefits for river health.

4. **Watts R.J.** & Wilson, A.L. 2004. Triage: Appropriate for prioritising community funded river restoration projects, but not for advancing the science of river restoration. *Ecological Management and Restoration* 5, 73-75.
Journal not listed for impact factors.

Publication #4 addresses the issue that the process for selecting sites to answer questions about the river restoration may need to be different to the process for prioritising sites for restoring the riverine environment. This is one of a group of publications on the theme of prioritisation of funding for river restoration works. This multidisciplinary research program has involved modelling of sediment in streams (undertaken by CSIRO Land and Water), assessment of riparian vegetation using remote sensing techniques, and comparison of remotely sensed data to field based assessments. An exciting aspect of these projects is that restoration works can be simulated in computer models, so that predicted outcomes of alternative management actions can be considered before managers make decisions about river restoration programs. This is an important tool for catchment managers who have to consider issues of social equity when allocating resources and implementing incentive programs. The impact of this body of work is best judged through its influence on riparian management. The research has helped set priorities for river restoration in several catchments. For example, the results from one of my peer-reviewed technical reports has been used by the Murrumbidgee Catchment Management Authority to implement a river restoration program and assist the allocation of funds in excess of \$1M for fencing and replanting of riparian zones. This program will contribute towards addressing water quality management targets as specified in the Murrumbidgee Catchment Blueprint.