ACHIEVING SUCCESSFUL CHANGE
Towards effects-based strategies in the GBR

Summary of a Flagship Fellowship report written by Dr Robert Ferrier, CSIRO Flagship Fellow 2006

Providing an independent and expert view on science challenges and CSIRO’s role in changing reef outcomes

Water is not a commercial product like any other, rather, a heritage which must be protected, defended, and treated as such.

OBJECTIVES OF THE FELLOWSHIP

- To enhance the scientific basis for sustainable watershed management based on shared knowledge linking European and Australian approaches
- To evaluate whether principles of the European Union Water Framework Directive represent a pertinent model for management of Australian basins
- To assess how the Water Framework Directive concept of ‘ecological status’ and environmental thresholds could provide appropriate impacts-based targets for management, and the consequences of this for future monitoring strategies
- To undertake a pilot evaluation of these Water Framework Directive principles in the Great Barrier Reef (GBR) catchment
- To provide an European perspective to research within the Water for a Healthy Country initiative in other key catchment areas

KEY ISSUES

- Are the principles of diffuse pollution assessment and management consistent between activities in Europe and Australia?
- Does promoting a systems-level approach to Great Barrier Reef science and the land – sea continuum provide a mechanism for integration and delivery?
- Is it possible to adopt an effects-based approach linking diffuse pollution to ecological impacts, and to integrate this within a wider socioeconomic framework?
- Do current objectives for water quality management in the Great Barrier Reef region adequately address the potential threat of diffuse pollution? What are the options for effecting further change?
- How can science provide the necessary underpinning to inform and support policy development?
- Is there potential for adopting ecologically based targets for water resource management in a wider context?

CSIRO FLAGSHIP FELLOWSHIPS

Flagship Visiting Fellowships were initiated in 2003 to enable distinguished university researchers to spend time in one of the National Research Flagships, to bring in valuable skills and to enhance the intellectual leadership of Flagship research.

Visiting Fellowships are one component of the $97 million Flagship Collaboration Fund, designed to enhance collaboration between the Flagships, universities and other publicly funded research agencies.

Sharing knowledge

Managing diffuse pollution

Using effects-based systems management
THE GREAT BARRIER REEF

The Great Barrier Reef (GBR) is 2000 km long and contains the world’s largest marine protected area. Run-off into the GBR lagoon comes from 423 000 km² of mainly grazing and cropping land where savannah, woodlands and forest have been cleared or thinned, and significant areas of wetlands have been lost.

Export of nitrogen and phosphorus is high and increased hillslope erosion rates have resulted in increased nutrient and sediment loads reaching and influencing inner shelf reef and benthic ecosystems. These pollutants are generated from diffuse sources and evidence from other geographical locations suggests that by the time their widespread effects are identified, the reef systems will be irreversibly damaged.

Remediation needs to focus on land stewardship over large spatial scales and must address actions of individual citizens as well as private and public entities.

We therefore need a systems approach that represents sources and sinks of pollutants and is constrained only by boundaries relevant to the point of impact. The key science challenge is to provide a solid platform for policy development and implementation.

WATER FOR A HEALTHY COUNTRY FLAGSHIP

Research by the Water for a Healthy Country Flagship is providing solution science to support landholders, decision makers and the community with the implementation of the Reef Water Quality Protection Plan. It aims to improve water quality, wetland integrity and productivity, while enhancing regional community wellbeing and protecting Reef-based industries from declining water quality. Research is focused on:

- identifying where contaminants are generated and delivered
- identifying key social, economic and institutional structures
- quantifying uncertainty and risk associated with interventions and
- developing reliable indices and effective tools to enable integration of biophysical, social and economic data.
REEF PLAN

The Reef Water Quality Protection Plan (Reef Plan) was formulated to address the problem of broadscale diffuse pollution entering the GBR lagoon. It acknowledges that diffuse pollution is a major driver of change, and that time-based objective targets are needed. Reef Plan highlights the importance of wetland ecosystems in reducing pollution, and looks towards the conservation and rehabilitation of these critical ecosystems.

The Reef Plan provides a long-term, environmental management mechanism that addresses the need for better integration of Australian and state government legislation and the wide range of funding that is available. It acknowledges that management of the region is complex, needing to balance social and economic as well as environmental factors in a multi-use environment.

The Reef Plan also arose from acknowledgement of the size of the GBR, its complex ecology and limited resources. It was deliberately formulated as an action-based policy using enhanced collaborative and community based approaches to resource management.

While Reef Plan is a substantial start, its implementation over time needs to move beyond reducing and managing pollutant generation. This will not necessarily manage pollution impact. Uncertainty about the ecological consequences of the implementation of Reef Plan has not yet been adequately evaluated and the consequence of implementing best management practice across all sectors is not known. The level of environmental protection achievable through Reef Plan should be critically evaluated as a priority and as part of the evolution of Reef Plan.

Reef management needs to move towards a fully ecosystem-based approach. Pollutants may also need to be removed from the system and feasible and affordable time scales and targets may be needed for this process. Looking beyond Reef Plan, future challenges and management options will require increasingly robust biophysical underpinning, and socioeconomic evaluation. The initial focus has been placed on implementation; now a longer-term vision to support future policy needs to be developed.

A true systems approach will extend the relevance of this research and skills developed in it, to beyond the GBR region. The development of the Reef Water Quality Partnership and its supporting Scientific Advisory Panel provide a vehicle for this move to a more substantial systems approach.

Further information is available from:
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Reef Plan: a long-term environmental management mechanism

Towards an ecosystem-based approach
In their Water Framework Directive, the European Community of countries have shifted from traditional use-based management to management that maintains and improves ecological quality. Each water body type is assigned a reference condition and then classified. Appropriate environmental objectives through which to remediate the aquatic environment to achieve at least good status by 2015 are put in place. No further deterioration in the ecological quality of any aquatic environments must occur concurrently.

In applying similar principles in the GBR region, similar reference standards and conditions would need to be developed using our knowledge of the environmental conditions that support healthy ecosystems within the lagoon and reef. Consideration should be given to the consequences of adopting an approach based on ecosystem protection, rather than use, to management of Australian water bodies.

Linking impact to physical, chemical and habitat criteria, would then form the basis of an effects-based approach to management.

Key components of the effects-based strategies of current environmental policy in Europe and North America are the critical load (the pollutant load below which significant harmful effects do not occur) and the critical level (the pollutant concentration above which adverse effects do occur).

Current research suggests that an effects-based diffuse pollution policy could be developed for the GBR, with regional and sectoral source apportionment, and subsequent target setting. Ecological response in the lagoon would guide the setting of thresholds or standards for land-based diffuse pollution. Links between cause and effect should be consolidated and an adaptive framework for effects-based management developed.

Possible delay times in recovery following intervention should form a crucial part of management planning. They are a function of other ecosystem processes such as recruitment and food web linkages; whether a change in state has actually occurred; and how a policy is implemented. Long time lags and concerns about environmental improvement may result in social and political pressures to accelerate the recovery process. The development of appropriate predictive dynamic models (through which to address hysteresis and timelags) should be supported either in-house or through enhanced collaboration.

Variability in ecosystem characteristics, data, and model uncertainty must be realised as integral parts in any assessment.

Some conditions may not be able to be reversed within available budgets, and targets will need to be set on this basis. In addition, other factors such as climate change or societal pressures may influence not only the rate of any expected recovery but also potential or desired end points.

Reef Plan has generated a momentum within the stakeholder community for adopting best management practices and this should be encouraged. However, further measures may also be required to protect the reef and lagoon. The consequences of this and the ability to build capacity through which to respond to this challenge should be evaluated.
EFFECTING CHANGE

Every land management situation is different and management strategies must be tailored to meet specific challenges across the GBR.

Targets need to be linked to cause and effect criteria and based on lagoon ecosystems. They can be set as an arbitrary value or based on some previous condition. They also need to be monitored to determine efficacy. Assessment of the success of any strategy must be based on ecological response supported by action indicators such as the scale of uptake by landholders or best management practice.

Setting target loads for the GBR ecosystems as cumulative end-of-river contributions would deliver a way to specify emissions or pollutant limits and therefore enable emissions or permit trading. This would allow greater flexibility, but would need standards to be set, monitored and enforced.

Further research into wetland function and how it has been influenced by management is needed. The wider systems-level functions of wetlands as ‘reactor vessels’ in the context of the GBR, and especially pollutant delivery need to be evaluated.

A key measure of Reef Plan success has been the development and implementation of water quality improvement plans in a number of contributing catchments. These community and regionally led initiatives show an impressive amount of local engagement between state, shire, producers, stakeholders and public. In comparison, the Australian Government, State, and regional GBR resource management strategies are complex and poorly integrated and do not reflect a system-level approach. Institutional analysis should be carried out to identify ‘friction points’ within and between different strategies and to consider available options for streamlining objectives and operational procedures.

The efficacy of different best management practices needs to be examined to identify areas that need more stringent management and to consider how to achieve target thresholds through voluntary and regulatory approaches.

A mechanism for facilitating shared visions is needed. The proposed top-down effects-based approach must mesh with the social bottom-up community-focused initiatives. Developing appropriate structures through which to dovetail these components is a major issue that is already being addressed by the Reef Water Quality Partnership – a group composed of community and government agencies. Its work plan is developing targets and monitoring and reporting on management actions, pollutant loads and receiving water health.
INTEGRATION AND COLLABORATION

Research in the GBR is high quality, innovative, collaborative and has the potential to be more than the sum of its parts. Collaboration could be strengthened by consolidating visions and systems-level issues, and ensuring that data and information are more formalised and that monitoring is coordinated. Given that land-based industries are the principal source of diffuse pollutants, CSIRO should take the lead in developing a platform for increased coordination of research.

Integration should be supported as a new initiative based on the principles of systems science. It should generate conceptual understanding, identify areas that require additional support, integrate uncertainty, and enhance and develop existing and new partnerships. The program requires visionary leadership and committed management, and potentially, additional skills and resources.

Collaboration requires mechanisms that ensure interaction and engagement in specific scientific objectives. The integration of social scientists and economists within the GBR science platform is providing a leading edge, but needs additional support. Greater integration of CSIRO biogeochemists and aquatic ecologists within the GBR node should be promoted. Management should reappraise skills and resource allocation against science plan deliverables and identify gaps.

Integration of scientists and their activities needs to be at a range of levels. A targeted program of research for measuring success of management options and based on simple indices that can be source apportioned and a common understanding of the problem to be resolved is needed.

A formalised mechanism of engagement for contributors and a way to absorb transaction costs may need to be developed. Proactive engagement should be seen as a priority.

The Water for a Healthy Country Flagship is developing national capacity with respect to many aspects of land and water management. This will be of increasing importance in the coming decades, and it is important to ensure that critical mass is maintained beyond the life time of the science plan. The Flagship should also look past its national commitments and consider how to develop a greater international profile through collaboration with organisations such as the International Human Dimensions Programme on Global Environmental Change and the UN Environment Programme. Consideration should be given to formalising such engagements.
The Water for a Healthy Country National Research Flagship is a research partnership between CSIRO, state and Australian governments, private and public industry, and other research providers. The Flagship was established in 2003 as part of the CSIRO National Research Flagship Initiative.

This booklet on effects-based change in the Great Barrier Reef region is derived from a report written by Robert Ferrier, a visiting CSIRO Flagship Fellow.

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His research has focused on the development and application of predictive modelling approaches for the evaluation and implementation of effects-based European environment policy. He has championed the global issue of diffuse pollution as one of the major challenges affecting land and water management in the coming decades.

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