

JOHNSTONE CENTRE

Report No. 171

Notes from an adaptive management workshop Lake Hume, July 24 / 25 2002

Compiled by Catherine Allan and Allan Curtis
with the assistance of the workshop participants

February 2003

Albury, NSW



Johnstone Centre, Albury NSW

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Adaptive Management Workshop (2002 :Lake Hume)

Notes from an adaptive management workshop, Lake Hume, July 24-25, 2002 / compiled by Catherine Allan and Allan Curtis ; with the assistance of the workshop participants.

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Thanks to Alistair Gilmour, Warwick McDonald, George Stankey, Helen Anderson, Andrea Grant, Bruce Mapstone and John Ive for their contributions to drafts of this report. Thanks also to Lynda Wilson for administrative support.

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EXECUTIVE SUMMARY

Introduction

Since the term “adaptive management” was coined in the late 1970s it has come to encompass three separate approaches to managing natural resources, described as evolutionary, passive and active (Walters & Holling 1990). *Evolutionary adaptive management* is eventual learning from experience, or trial and error. *Passive adaptive management* is more directed, using lessons from history to develop a single best policy to apply in practice. Both evolutionary and passive adaptive management are common approaches to managing natural resources. *Active adaptive management* is a change in the way management is undertaken. It is an approach to natural resource management that consciously uses policy and implementation as experiments, designed to enable people to learn about systems as they manage them (Lee 1993a; Walters & Green 1997; Johnson 1999a).

Adaptive management is said to underpin most Australian natural resource management strategies (Alexandra et al. 1998). Many new regionally focused catchment plans and blueprints are being required to incorporate adaptive management principles (e.g. Murray Catchment Board 2001; North East Catchment Management Authority 2002). However, locally relevant information about adaptive management is difficult to obtain, and the workshop organisers could see little evidence of active adaptive management underpinning management at the regional scale.

Allan Curtis (BRS) and Michael Lockwood, (CSU) hosted a two-day adaptive management workshop at Lake Hume in July 2002. Catherine Allan, a PhD student at CSU, co-ordinated the workshop and authored the briefing paper included in this report.

The workshop aimed to

- reflect on the current experience of active adaptive management in Australia, and
- foster efforts to implement active adaptive management at regional scales.

Dr George Stankey, from the United States Department of Agriculture’s Forest Service, was keynote speaker at the workshop. George’s experience with adaptive management includes his role in the team that recently evaluated the Adaptive Management Areas Program in the Pacific Northwest (Stankey in press). At the Albury workshop George worked with agency staff, natural resource managers and academics from Queensland, New South Wales and Victoria at the workshop.

Presentations from George Stankey, Tony Ladson, Tony Meppem, Bruce Mapstone, Alistair Gilmour and Ockie Bosch on aspects of adaptive management stimulated discussion on its theory and practice. The key topics identified at the workshop were:

- Scope
- Requirements
- Objectives

- How to do it (incorporating constraints)
- Stakeholder engagement
- Institutions
- Monitoring and evaluation
- Uncertainty / risk
- Values
- Learning
- Models
- Capacity building for practitioners

Four of these topics were explored in detail by small groups. The outcomes from these group discussions are summarised in the next section.

Outcomes from group discussions

How to do adaptive management

Steps to take:

1. Establish potential stakeholders or audience for the project
2. Communicate principles of AM to potential stakeholders
3. Provide a body of evidence, including case studies, to the decision-makers and gain mandate to execute project
4. Identify and invite stakeholders to participate in project
5. Agree process, document the agreement and manage expectations
6. Scope and clarify issues and key questions from a stakeholder viewpoint
7. Agree problem space and boundaries
8. Build a conceptual model of the issues and linking processes that represent the hypotheses about the issues/system
9. Identify and document assumptions
10. Review stakeholder participation in light of issues/processes/actions identified in #8
11. Agree nature and extent of stakeholder commitment to action
12. Agree on objectives, both short and long term, and criteria for achievement of outcomes
13. Agree on measures or indicators of system inputs, performance and outputs
14. Identify key uncertainties
15. Develop a range of policy/management options or possible strategies that address the desired outcomes and acknowledge the key uncertainties
16. Agree on a preferred strategy
17. Prepare a plan for implementation that defines the system, the actions to be taken under the preferred strategy and those responsible for them, achievement criteria and timeframes
18. Design system monitoring program and data management plan
19. Agree evaluation framework
20. Complete documentation of project
21. Implement preferred strategy
22. Review and evaluate system monitoring data
23. Identify key learning outcomes
24. Revise models, objectives, actions including policies, stakeholders and plan (i.e. return to item 4 above)

Monitoring and evaluation

How to institutionalise monitoring:

- Plans include monitoring and evaluation explicitly
- Create collaborative learning environments, eg making sense workshop, Internet
- Everyone gets together and reviews data and changes the strategy
- Provide guidelines, cookbooks that can be used flexibly or regularly revised
- Legitimise monitoring as an activity

- Legislate for monitoring
- Monitor the monitoring
- Effectiveness review
- Clear demonstration of benefits
- Filling knowledge needs

Stakeholder engagement

Aiming for:

- Pervasive process of AM philosophy. Principle- maximum stakeholder engagement
- Fit for purpose stakeholder engagement / relevance
- Time critical involvement, key decision points: planning, evaluation
- (But it's difficult. Too hard?)

Steps to take:

- Institutional change, so it becomes part of what you have to do
- Stakeholder analysis for core stakeholders
- Optimising, rather than maximising
- Ensure stakeholders have a role in making decisions. Need to be explicit about role

Uncertainty and risk

What are we aiming for?

A culture:

- where uncertainty is embraced as an "opportunity"
- where risk is managed, not avoided
- of shared responsibility
- which focuses on carrots, not sticks

What constraints are there?

- Sanctions on error. Punishment of failure
- Punishment is channelled to individuals

Steps to take

- "I don't know" should be tested. Maybe it means "I (we) need to learn"
- Agency (and other?) performance measures should be tied to
 - process (for example setting up appropriate evaluation)
 - articulation, documentation and reflection
 - team approaches

Building on the workshop

Reflections

Towards the end of the workshop participants were asked to reflect on the main outcomes of the workshop for them, to identify topics that had been neglected, and to suggest actions that would build on the workshop outcomes. A summary of participant's contributions is provided below.

- Involve other people
- Capture this learning
- Produce a monitoring "cookbook"
- Develop iterative reporting
- Look harder at obstacles
- Develop strategies in detail using cases
- Peer support - this group
- Initiate network
- Use this information to add to current management
- Scaling up

- Document examples / case from Australia
- Resource material
- Think about adaptive management for institutions /organisations
- Computer aided conferencing
- Monitoring community learning

Actions

Specific actions identified by workshop participants are summarised in the table below.

Action	Responsible people	Time
Produce workshop report	Catherine Allan	Draft September 2002 Distribution October 2002
A communiqué based on the workshop report be submitted to an appropriate Australian Journal	Catherine Allan & Allan Curtis	November 2002
A paper looking at “what if it were done adaptively” to be developed. The central study of this is the NE Regional Catchment Strategy, with possibly the Murray Board’s Blueprint also considered.	Lead people: Tony Ladson and Jeff Taylor, with support from Paul McGowan, Rex Candy, Bruce Mapstone, Tony Dawson, and Alistair Gilmour	January 2003
Compilation and description of Australian case studies	Hamish Cresswell, Rex Candy, Tony Ladson and Catherine Allan.	February 2003
Web conferencing or email list	Johnstone Centre, Charles Sturt University, Catherine Allan to follow up.	October 2002
Workshop 2003	Steering committee: Allan Curtis, Warwick McDonald, Alistair Gilmour, Ockie Bosch, Pat Feehan, Bruce Mapstone, and Catherine Allan.	Allan Curtis to chair a steering committee meeting in Canberra in February 2002.
Present adaptive management information to senior policy people		To be discussed at next workshop?

INTRODUCTION

Since the term “adaptive management” was coined in the late 1970s it has come to encompass three separate approaches to managing natural resources, described as evolutionary, passive and active (Walters & Holling 1990). *Evolutionary adaptive management* is eventual learning from experience, or trial and error. *Passive adaptive management* is more directed, using lessons from history to develop a single best policy to apply in practice. Evolutionary and passive adaptive management are common approaches to managing natural resources. *Active adaptive management* is a change in the way management is undertaken. It is an approach to natural resource management that consciously uses policy and implementation as experiments, designed to enable people to learn about systems as they manage them (Lee 1993b; Walters & Green 1997; Johnson 1999b).

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This report provides a list of workshop participants, an explanation of the workshop process, a summary of the discussions held, and some communication initiatives to improve support for practitioners as they move adaptive management from theory into practice.

PARTICIPANTS

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THE WORKSHOP PROCESS

The workshop began with presentations on aspects of adaptive management. The presenters were:

- George Stankey, United States Department of Agriculture, Forest Service, Oregon.
Adaptive Management at the Regional Scale: Breakthrough Innovation or Mission Impossible? A report on an American Experience
- Tony Ladson, Cooperative Centre for Catchment Hydrology, University of Melbourne.
Is adaptive management of large river basins possible?
- Tony Meppem CSIRO Sustainable Ecosystems, Indooroopilly.
Building capacity for adaptive management: experiences from two community based regional initiatives.
- Bruce Mapstone, Sustainable Industries Programme, CRC Reef.
Institutional and objective uncertainty: obstacles to the implementation of active adaptive management
- Alistair Gilmour, Graduate School of the Environment, Macquarie University.
Better Adaptive Management?
- Ockie Bosch, School for Natural and Rural Systems Management, University of Queensland
Adaptive management and knowledge building – a success story by the year 2022

During the presentations and subsequent discussions participants were encouraged to write their comments, observations and questions onto cards. The cards were collected, sorted and labelled to provide a record of the key topics that arose during the day.

Some time was taken to define adaptive management to the satisfaction of all participants.

On day two the sorted cards were reviewed by all participants, and the key topics confirmed or modified. Participants then voted on the key topics that they thought should be discussed further that day. Four topics were selected, and four small groups formed to discuss one topic each. Nearly two hours was allowed for these discussions before the participants reconvened to share outcomes with the other groups. After reflection on the workshop a list of actions was developed. The workshop process is presented graphically in Figure 1, and described in more detail in relevant sections of this report.

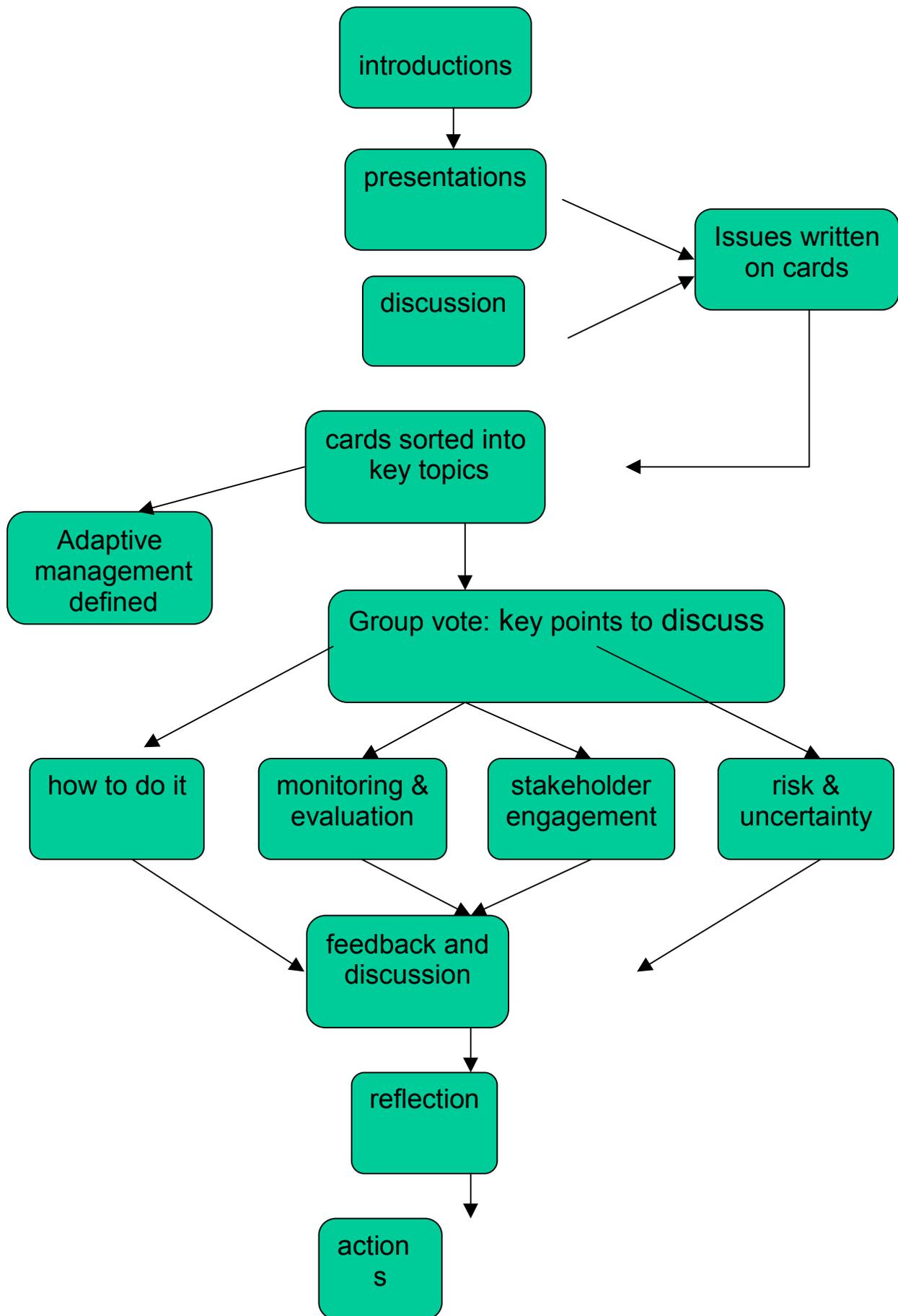


Figure 1 Adaptive management workshop process

ADAPTIVE MANAGEMENT

Early in the workshop it became apparent that, even among our gathering of people with a strong interest in adaptive management, there was little common ground about the nature, scope and requirements of an active adaptive approach. Each participant brought different experiences and expectations to the workshop. Each also attempted to make some rational union between their current operating frameworks and an adaptive approach. Some participants considered adaptive management to be a management philosophy, within which management policy and implementation could be reconstructed. Others saw adaptive management more as a management tool for use, when appropriate, within existing frameworks. The group chose to develop a shared working definition of adaptive management, a shared picture of what adaptive management includes, and some prerequisites for success:

A definition

Active adaptive management is a designed, purposeful and reflexive system that:

- grows, assesses and incorporates emerging knowledge and context; and
- builds the capacity of stakeholders to manage change.

An adaptive management project includes:

1. Formal hypothesis testing/ question formulation
2. Engaged stakeholders making decisions
3. Confronting uncertainty
4. Transparent process
5. Implementation and monitoring

Prerequisites for successful adaptive management:

1. Learning by doing
2. Communication
3. Reflection

PRESENTATIONS

Six participants presented case studies at the workshop, sharing their experiences with aspects of adaptive management. Summaries of these presentations were prepared by the report authors, and are presented below.

George Stankey

United States Department of Agriculture, Forest Service, Corvallis, Oregon

Adaptive Management at the Regional Scale: Breakthrough Innovation or Mission Impossible? A report on an American Experience



By the early 1990s forest management in the Pacific Northwest had become a political battleground. On the one hand were calls to save the endangered Spotted Owl and stop logging in old growth forests; on the other were jobs for timber workers and regional wealth.

President Clinton convened the Forest Ecosystem Management Assessment Team to develop a plan to manage the forests to achieve multiple outcomes. The Plan is evolutionary, driven by scientific enquiry and adaptive management.

Evaluation of the Plan revealed:

- a disconnect between vision and implementation
- exclusion of key stakeholders
- inadequate exploration of the implications of an adaptive approach

- a collision of world views, with people holding different beliefs about
 - what is knowledge, who holds it and how it is used
 - attitudes about risk and uncertainty

- attitudes to risk and uncertainty lead to a Catch-22 phenomenon. Want to prevent harm from happening, but what if we don't know where harm comes from? This uncertainty makes experimentation critical, but...

- forest managers claimed that they had always been adaptive, and there was much confusion between "muddling through" and adaptive management.

- there were confusing and competing definitions of adaptive management. Also confusions of means and ends.

- there was resistance to formal learning.

Conclusions

- Despite good intentions, adaptive management has failed to achieve its promise
- Role in the plan was not well understood or supported- lack of funding, resources, political support
- The evaluation found little to evaluate

What would a successful adaptive organisation look like?

- Learning as a performance element
- Engage risk and uncertainty
- Treat adaptive management rigorously and formally
- leadership and clarity of vision

- non- compartmentalised organisation

Can an adaptive approach work? Yes but...

- needs leadership and both technical and political support
- neither quick nor cheap
- requires specific skills, processes and structure

Can adaptive management work for us?

- Treat the rhetoric seriously
- Have realistic expectations
- Foster understanding and support
- Remember all the parts
- Choose opportunities wisely
- Build networks
- Be patient but persistent

Tony Ladson

Co-operative Centre for Catchment Hydrology, University of Melbourne (currently Civil Engineering, Monash University).

Is adaptive management of large river basins possible?

This presentation also explored cases from the USA, and the first case also began with a controversy, this time over large dams and their impact on salmon. Dams, along with fish harvesting, irrigation diversions, ocean conditions and global warming, impact on the salmon survival. Adaptive management was one approach to managing the salmon problem in the Columbia River. Begun in 1984, the adaptive management program had, at best, mixed results.

What went wrong?

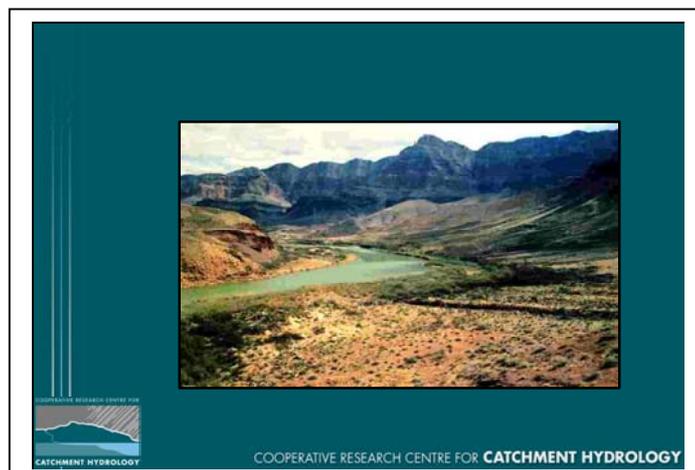
- Modelling wars
- Institutional complexity
- Politicised management
- Complications from the Endangered Species Act
- Too much at stake to experiment

The second case involved the Mississippi, important for its environmental significance and navigation system. Issues included changed flow, exotic species, water quality, fish mortality, disposal of dredge material and changed topography. Adaptive management was attempted through building a model, but then everyone went their own way.

What went wrong?

- Lack of faith in the model
- Adaptive management was a threat to existing programs
- Experiments are seen as too costly, or too risky
- Lack of data to guide and validate
- Jurisdictional issues
- Ways forward outside the adaptive management process.

The third case was the Colorado River. Issues included loss of native fish species caused by cold water and exotic competition. Adaptive management on the Colorado involved the development of a conceptual model, which showed that warming the downstream of Glen Canyon dam wouldn't necessarily help native fish, and that better monitoring was needed before experimenting. Policy experiments involved a beach building flood in 1996, habitat modifying floods in 1997 and low steady summer flows in 2000.



What went right?

- Few jurisdictional issues
- Few levers
- Credible science
- Common goals
- Nothing outside the adaptive management process
- Early success
- Broad tax base

Lessons for Australian Rivers

Are there problems worth solving?

- Water allocation
- Salinity
- Carp
- Declining native fish populations

Where can adaptive management help best?

- Fewer stakeholders
- Few jurisdictions
- Credible science
- Lots of data
- Small number of effective levers
- Inclusive process

Tony Meppem & Jenny Bellamy

CSIRO Sustainable Ecosystems, Indooroopilly

Building capacity for adaptive management: experiences from two community based regional initiatives.

In the past the focus for natural resource management was on a single issue and was usually sector based. There is increasing recognition of need for more integration across sectors, disciplines and issues. Some contemporary Policy rhetoric includes:

- adaptive institutions
- empowerment
- legitimacy of process
- collaboration
- participation
- whole of Government

Problems:

- lots of plans but little implementation
- no view that can interpret relations among system components
- inability to respond to
 - changing circumstances
 - understandings
 - perspectives
 - power relations
 - institutional arrangements

Case study 1: CHRRUPP

This 4 year R& D experiment aimed to establish an integrated approach to regional resource use planning. It involved individuals, groups and industry from 15 sectors from Central Queensland, in particular the Central Highlands.

It used a two tiered approach to building capacity

- increase the understanding of natural resource management so that each sector can undertake their own planning
- negotiate regional solutions to shared problems

Three cornerstones for a healthy adaptive management system:

- support for individuals and sectors to develop their own planning and management capacity

- facilitating better understanding of the social, economic and biophysical processes within regions
- stronger institutional arrangements that facilitate negotiation between these interests

Case study 2: Aboriginal Regional Planning

- focused on the Northern Tablelands of NSW
- ongoing
- being championed by NSW Aboriginal Land Council
- CSIRO provides policy development support

There are many area-based management initiatives seeking greater involvement of Aboriginal people. Building their capacity to engage involves:

- New policy approaches which are
 - exploratory and experimental
 - dependent on the capacity for sectors to engage in negotiation
- Sectors must develop their own area based strategic planning endeavours to engage in negotiation
- NSW Aboriginal people are not in a strong negotiating position re this new policy arena
- To adequately respond will require processes for enhances collaboration among aboriginal people and their organisations

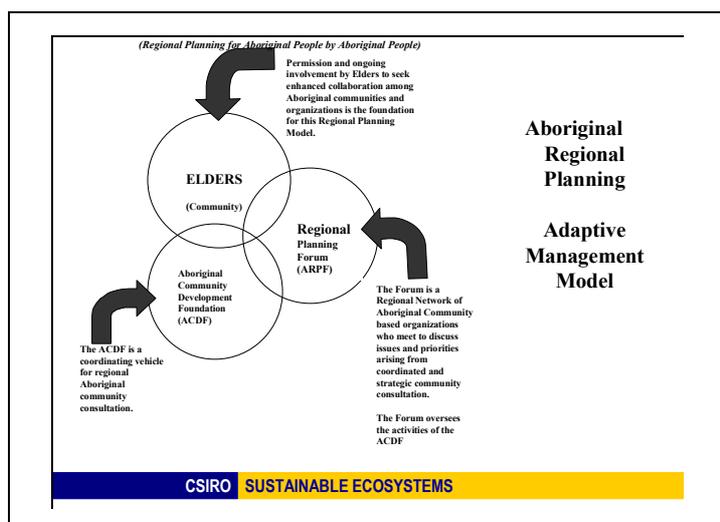
The new policy agenda of the NSWALC is aimed at how aboriginal people might develop their own policies, rather than consult on government policies.

The Northern Tablelands Planning Forum (NTAPF) has developed as a network meeting among aboriginal groups. This strategy aims to enhance the capacity of the Aboriginal sector to collaboratively negotiate in wider regional planning agendas.

Aboriginal Capacity to engage:

- Driven from the “grass roots”
- Putting rapidly increasing demands on people in NTAPF
- More real co-operation
- Good things happening
- Needs more co-operation and negotiation to keep going

The next stage is about developing an Aboriginal Community Development Foundation (ACDF) for additional support



Conclusion

Four core principles for healthy adaptive management:

1. Development of sector capacity to engage
2. Enabling institutional arrangements to support cross sector negotiation
3. Appropriate information/forums to support processes
4. Evaluate frameworks to determine the effectiveness of policy and to support learning for adaptive management

Bruce Mapstone

Program Leader, Sustainable Industries Programme
CRC Reef

Institutional and objective uncertainty: obstacles to the implementation of active adaptive management

Desirable context for (active) adaptive management

- Options for alternative management strategies
- Specific objectives against which to assess performance
- Cross sectoral support
 - Management agencies and instrumentalities
 - Industry sectors
 - Community interests
- Clear and open mechanisms for information transfer
- Continuity of commitment
- Buffered against political expedience

Case study: the Great Barrier Reef

This is a large area with great biophysical diversity. It is a World Heritage Area, which includes

- A multiple use marine park
- Shipping
- Tourism
- Commercial, recreational and charter fishing

The Marine Park and World Heritage area are managed by a Commonwealth Statutory Authority (GBMPA), while the fisheries are managed by the Queensland Fisheries Service of the QDPI.

AAM Potential?

- Array of management options
- Large, spatially structured domain
- Relatively low population
- Statutory authorities
- Long term commitment to ES(D)
- Relatively few industries

But...

- Motherhood conservation objectives
- Fuzzy fisheries objectives
- Some monitoring
- Little management outcome assessment



The Reef Line Fishery in the GBR is multi-sectored, based on multiple species, and is information poor. Management Strategy evaluations

- Formally compare relative performance of alternative strategies to meet specified objectives
- Explicitly identify trade-offs among competing strategies
- Require quantitative objectives and performance indicators

ELF experiment- a large scale manipulative approach – in spirit of active adaptive management

- GBMPA initiative (1989)
- Objectives
 - Provide key parameters for Management Strategy Evaluations
 - Assessment of zoning strategy in the GBR Marine Park
 - Biology of harvested species
- 24 reefs
 - 4 clusters of 6 reefs/cluster
 - 4 closed reefs, 2 open reefs cluster
 - long term (> 10 years)
- Monitoring

Issues for ELF Experiment

- Politically controversial & administratively difficult
 - Required legislative amendments to zoning plans
 - Allowed fishing in highly protected areas
 - Alleged 'client capture' because of strong industry support
 - Political interference in agreed processes
 - Major nuisance for bureaucrats
- Uncertain relevance
 - Poorly developed management objectives
 - Why bother?
 - Links to management decisions?
 - Major products for fishery management (State), legislative context was conservation management (Federal)
 - High staff turnover with little bureaucratic memory
 - Weak & variable commitment from one or other management agency

Some things that changed

- Clear management objectives
 - Specified collectively by stakeholders & researchers
 - multi-faceted, desirable, feasible
- Monitoring & feedback
 - The ELF Experiment & ELFSim
- Information transfer & cross-sectoral support
 - Liaison officer
 - Engagement with management issues
 - Media
 - Information transfer
 - Managed impartiality
- Continuity of support (above!)
- BUT – process driven by research, not by management

General Issues for Active Adaptive Management

- Incongruence between management jurisdictions
 - Demarcation of issues (e.g., fisheries vs conservation)
 - Conflicting management objectives – *if* specified
 - Competing legislative frameworks - different parliaments
 - Different enforcement regimes
 - Non-reciprocal penalties for infringements
- Inconsistent management visions
 - Concepts as objectives – unwillingness to be specific
 - Management commitment depends on champions
 - Fear of uncertainty – managers are bureaucrats, not scientists
 - Poor engagement between managers & scientists

Conclusions

- Current management paradigms:
 - Disparate, fuzzy vision
 - Motherhood objectives
 - Desire for stability
 - Political perspective (3 years)
 - Fear of uncertainty
 - Science as convenient (reciprocated)
 - Diminishing budgets
- Active adaptive management:
 - Clear, shared vision
 - Specific outcome objectives
 - Commitment to change
 - Long term perspective (decades)
 - Embracing of uncertainty
 - Science & regulation as partners
 - Lots of money
- The first hurdles in moving from Current management practices to AAM:
 - Objective clarity
 - Institutional security

Alistair J. Gilmour

Emeritus Professor Graduate School of the Environment
Maquarie University

&

Greg Walkerden

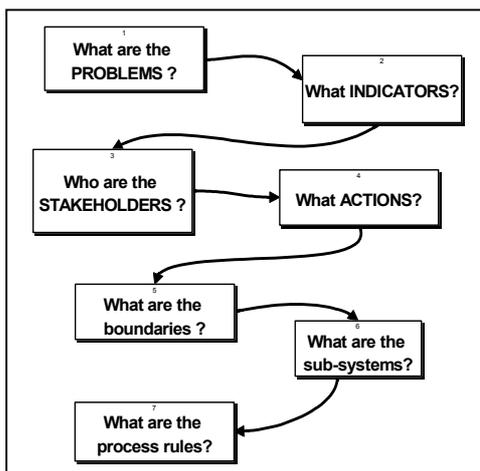
Environmental Systems Manager
Wyong Council

Better Adaptive Management?

This presentations draws on 3 cases from the Sydney area, Tuggerah Lakes, South West Catchments and South Creek. Each used an Adaptive Environmental Assessment and Management (AEAM) approach to develop management options for urban fringe water ways, and:

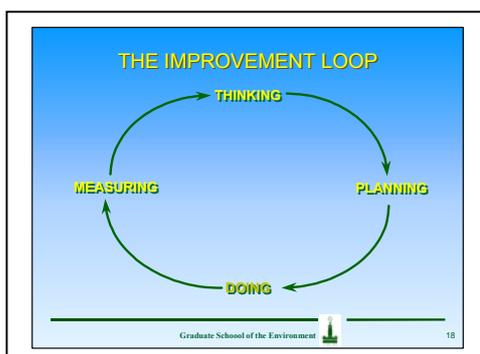
- took a systems view
- had broad stakeholder representation
- were effective at bridging technical and managerial gaps
- addressed uncertainty by 'what if?' questions
- provided groundwork for adaptive management

The Tuggerah Lakes AEAM Project is designed to look forward to the next twenty years and help both Council and the community evaluate the issues or problems facing the lake, and the possible actions to minimise those problems.



The project aimed to develop a decision support model to assist in the rapid evaluation of alternative policy strategies for the management of the Tuggerah lakes and their catchments. Workshop participants included the Wyong council, the Wyong community, State agencies and specialists. The outcomes were

- a decision support tool to evaluate a wide variety of potential management scenarios
- participation of community, councilors, staff and specialists in the development of the tool and its use
- improved communication among the various stakeholders
- a basis for prioritisation of data needs for management focused research



Implementation issues:

- creating information flows that work for managers
- difficulties of getting experimental management to work
- place more emphasis on negotiation and less on science?
- Managing for multiple resolutions in planning

Conclusions from the three cases:

Frame adaptive management planning processes

as negotiations from the beginning

- Need to address two different policy resolutions
 - Inter-stakeholder negotiations
 - Organisational planning processes
- A cautious approach to active adaptive management or experimental management
- A passive adaptive management approach is much easier to implement in practice

Some salient literature

- Iterative design of adaptive policies [Walters 1996]

Adaptive management workshop 2002

- Transcience [Weinberg 1972]
- Resource management: lessons from history (Ludwig et al. 1993)
- Uncertainty, lessons from history (Ludwig et al. 1993)
- Environmental disputes are at least as much value disputes as scientific controversies [Suskind & Weinstein]
- Provention (Burton 1991)

Conclusions:

- Education of stakeholders
- Vehicle for bargaining to change balance of power- a political process
- Active adaptive management may not be practical with many stakeholders who are intimately involved
- Informs policy formulation and review process
- Provides a focus for research design and prioritises data needs

Ockie Bosch

School for Natural and Rural Systems Management
The University of Queensland

Adaptive management and knowledge building – a success story by the year 2022

Research and management cycles are not always integrated

- No co-learning
- Local and traditional knowledge not valued
- Resource managers expected to integrate
- Resource managers not involved in information management, lack of ownership
- Knowledge accumulates in separate domains
- Poor understanding of each other's views and beliefs
- Difficult to select from wealth of unlinked information

Can we link science and management more effectively by creating collaborative learning environments and managing information better?

Integrated Systems for Knowledge Management (ISKM) version 1, developed a participatory approach that builds on experiential learning and systems thinking. This addressed many of the integration problems, but there was still a problem. Different stakeholders hold different assumptions about environmental processes and therefore favour different actions to solve problems. A mental model approach addresses this because it

- Brings experiential and scientific knowledge bases together
- Helps to identify system linkages in common and when they occur
- Helps the selecting from unlinked information
- Different landholders understand where and why they make different assumptions
- Makes main logical pathways explicit, opens them for exploration

ISKM version too, incorporating the mental models approach, is designed to :

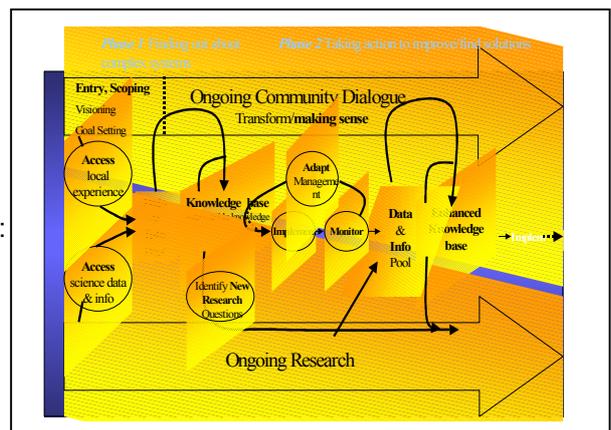
- Support an ongoing process of constructive community dialogue to develop practical resource management decision support
- Strengthen and enhance the application of tools and methods to promote participation and self-help in natural resource management.

Basic requirements for success are:

- involving stakeholders
- systems thinking
- adaptive management

The effectiveness of adaptive management as a mechanism for knowledge creation will depend on:

- institutional arrangements
- nature of collaborative learning environments
- willingness to share- sharing protocols
- monitoring as an integral part of management



FOUR KEY POINTS

Throughout the first day of the workshop each participant had access to A5 size cards and a marker pen. Participants were encouraged to use these to note down ideas, questions and comments that occurred to them during the presentations and associated discussions. At the end of the day this large pile of 'thoughts' was sorted into themes or key points by the workshop organisers, with help from many of the participants. The cards were stuck to the wall so that all be seen at once, and easily moved around. When people were satisfied with the sorting each group of key points was given a label. A full listing of the cards, in their labelled groups, starts on page 26.

Participants then selected key themes for further discussion that day. Each participant was allocated five sticky dots to distribute as votes in response to the question '*What is the most important topic to explore in our small group workshop?*'

The four highest scoring key points became the small group workshop topics. Participants organised themselves into four groups to discuss one topic per group. To assist that discussion they were asked to :

- describe /define the topic
- share experiences
- describe an aim?
- reflect on constraints/strengths
- list specific steps that could be taken

They were also asked to appoint a notetaker and someone willing to report on the small group discussion to the larger group.

Key point 1. How to do adaptive management (15 votes)

Tony Dawson, Allan Curtis, Bruce Mapstone, Hamish Cresswell, Alistair Gilmour, Helen Anderson

Doing Adaptive Management at a Regional Scale

The principles of an AM Project must include:

1. Formal hypothesis testing or question framing
2. Stakeholders making the decisions
3. A process that confronts uncertainty
4. Transparency to all
5. Implementation, monitoring and revision processes

There are some prerequisites that need to be met for an AM Project to succeed. These include:

1. Communication of the principles of AM to all stakeholders. The latter term is used here in a broad sense to include decision-makers, managers, technical specialists and community players.
2. A mandate to make the necessary decisions.
3. The support of the majority of stakeholders.
4. The necessary resources to carry out the project.

In establishing a set of steps for the design and execution of an AM project we have assumed that a framework, such as a catchment management plan or blueprint, exists. The plan includes a vision, a set of issues, a range of objectives, and a strategy.

The steps might then include:

1. Establish potential stakeholders or audience for the project.
2. Communicate principles of AM to potential stakeholders.
3. Provide a body of evidence, including case studies, to the decision-makers and gain mandate to execute project.
4. Identify and invite stakeholders to participate in project
5. Agree process, document the agreement and manage expectations.
6. Scope and clarify issues and key questions from a stakeholder viewpoint.
7. Agree problem space and boundaries.
8. Build a conceptual model of the issues and linking processes that represent the hypotheses about the issues/system.
9. Identify and document assumptions.
10. Review stakeholder participation in light of issues/processes/actions identified in #8.
11. Agree nature and extent of stakeholder commitment to action.
12. Agree on objectives, both short and long term, and criteria for achievement of outcomes.
13. Agree on measures or indicators of system inputs, performance and outputs.
14. Identify key uncertainties.
15. Develop a range of policy/management options or possible strategies that address the desired outcomes and acknowledge the key uncertainties.
16. Agree on a preferred strategy.
17. Prepare a plan for implementation that defines the system, the actions to be taken under the preferred strategy and those responsible for them, achievement criteria and timeframes.
18. Design system monitoring program and data management plan.
19. Agree evaluation framework.
20. Complete documentation of project.
21. Implement preferred strategy.
22. Review and evaluate system monitoring data.
23. Identify key learning outcomes.
24. Revise models, objectives, and actions including policies, stakeholders and plan (i.e. return to item 4 above).

Key point 2. Monitoring & evaluation (14 votes)

Tony Ladson, Ockie Bosch, Warwick McDonald, Pat Feehan, Tony Meppem

This group suggested that monitoring is a fundamental aspect of adaptive management.

Why?

Mechanism for feedback

Attributes of effective monitoring

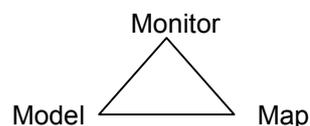
- Needs to be ongoing
- Need the goals/ targets
- Need monitoring and interpretation tools
- Easy access to knowledge
- Maximise usefulness of the new information to all stakeholders
- Packaging information
- Dissemination mechanism
- Feedback from stakeholders

What is monitoring?

- Data collection in relation to goals and targets
- Interpretation
- Use of information (the feedback loop)

Monitoring what?

- Determined by the goals/ objectives
- Effectiveness of process
- Equivalent of corporate memory
- Management actions
- Biophysical
- Effectiveness of management actions
- Environmental
- Economic
- Social
- Frequency matches time scales



Indicators as monitoring: useful for communication

Monitoring Framework

- Model
- Help stratify and design monitoring
- Parameterise models
- Help think about/understand the issue
- Collaboratively developed with stakeholders
- Use for learning, collective interpretation
- Review monitoring data

How to institutionalise monitoring

- Plans include monitoring and evaluation explicitly
- Create collaborative learning environments, eg making sense workshop, Internet. Everyone gets together and reviews data and changes the strategy.
- Provide guidelines, cookbooks that can be used flexibly or regularly revised
- Legitimise monitoring as an activity
- Legislate for monitoring
- Monitor the monitoring
- Effectiveness review
- Clear demonstration of benefits
- Filling knowledge needs

Ways of monitoring

- Methods
- Components of system
- About the process of monitoring
- Uptake
- Engagement
- Who does it (eg citizen science)
- Reporting back
- Tools
- Awareness raising monitoring (eg Waterwatch)
- Government moving from doing monitoring
- Work with those now doing the monitoring

Design issues

- Look for comparability's rather than consistency
- Dealing with natural variability
- Set monitoring up right at the start

Key point 3. Stakeholder Engagement (14 votes)

Jeff Taylor, Paul McGowan, Mike Gooley, Allan Bassett, Andrea Grant

This group concentrated on community engagement rather than broader issues of stakeholder engagement.

Stakeholders

Who is the stakeholder?

Representativeness: never achieve perfect representation, but

- consider all factors that may effect stakeholders
- define the interests (including value sets)
- give representatives the responsibility to cover / connect with all affected interests
- give representatives the resources to allow the above

Authentic participation vs serial participation

Expectations : need to surface the value sets of stakeholders

Why engage stakeholders?

Be explicit

Stakeholders need to understand the role they are to perform

- involves negotiation and learning

Value alignment / gender alignment / social engagement

Links community with policy makers

Diffuse opposition: get likely opponents "inside the tent"

Determine and address likely opposition

Multiple benefits

Long term support, allow iterative processes to occur

Aiming for

Pervasive process of AM philosophy. Principle- (maximum) or (rigorous) stakeholder engagement

Fit for purpose stakeholder engagement / relevance

Time critical involvement, key decision points: planning, evaluation

(But its difficult. Too hard?)

Steps to take

- Institutional change, so it becomes part of what you have to do
- Stakeholder analysis for core stakeholders
- Optimising, rather than maximising
- Ensure stakeholders have a role in making decisions. Need to be explicit about that role
 - Allocate resources to empower stakeholders
 - Training and appropriate tools

Key point 4. Risk / Uncertainty (12 votes)

Sarah Ewing, John Ive, Roel von't Steen, Catherine Allan

Some ideas that were thrown around:

- Uncertainty is a given. Risk is perceived because of that uncertainty
- Need broad understanding and acceptance that we do not have complete understanding, therefore risk is inherent in NRM
- Avoiding the nastiness
- Proceed on the basis of satisfying not optimality
- Processes need to be tuned to encouraging / accommodating change. Prepares people for realizing emerging opportunities
- Uncertainty provides opportunities to be receptive, so don't nip it in the bud. Recognise tension between individual risk and public/society gain. Free up 'system' so that it is receptive to new opportunities
- Uncertainty can be helpful- it encourages lateral thinking and helps us to think/move beyond our "comfort zone"
- First and only response to violation / non compliance is should not be punishment. May be a good thing if thought about.
- Reluctance of scientists to come openly engaged. Avoid the syndrome of always wanting more time / more resources. Never going to have complete information, so make best use of what we have and the weakest links and use to prioritise future requirements.
- Recognise that risk is involved with current management or "doing nothing"
- Guidelines are more flexible than policies (at least perception). As a result guidelines and reflection give the capacity for small changes (test the water) rather than the big jump associated with policy

What are we aiming for?

A culture :

- where uncertainty is embraced as an "opportunity"
- where risk is managed, not avoided
- of shared responsibility
- which focuses on carrots, not sticks

What constraints are there?

- Sanctions on error. Punishment of failure
- Punishment is channelled to individuals

Steps to take

- "I don't know" should be tested. Maybe it means "I (we) need to learn"
- Agency (and other?) performance measures should be tied to
 - process (for example setting up appropriate evaluation)
 - articulation, documentation and reflection
 - team approaches
- Multi documentation allowing tailoring to the mindset of different stakeholders/ participants and beyond

KEY POINTS (COMPLETE LIST)

The text from each of the cards from the first day is presented below, sorted into labelled key points.

How to do it (incorporating constraints)

- Will AM do more/less than other processes?
- The political- a tough nut to crack
- If the political cycle is short, and the consultation process necessary for AM is long...what institution can do AM?
- What NRM agency would give up "power" to a cooperative? Ditto politician
- Is there a role for critics? Eg researchers that don't work with managers but try to keep them honest?
- How a problem is framed
- Who gets to frame the problem?
- Problem definition takes time, beyond "issues". Learning as a means to an end (not just action)
- Challenge: management and research not integrated/linked, eg CRCM
- How to build understanding and commitment to AM amongst managers?
- How to engage processes at large scales
- The concept of "a plan" being the product of AM gives a perception of finality and completion. Rather it should be seen as providing a trajectory not a destination.
- How to establish processes that don't diminish independence/self help?
- Can we grow out of what we have already?
- Is it possible for AM to be confident about being in front of the game rather than continually playing catch up? (in worst case counter-cyclical)
- 60 days to treat the problem
- Is it possible to get the government to allow time to do the work?
- What resources are required for those negotiating the AM process?
- Time- what scope/how long do we give ourselves to learn?
- Who pays for the science? Who commissions the science?
- Discontinuity between planners and implementers- understanding/ ownership. Problems arise
- Been adaptive but embrace adaptive
- How can we address the issues mentioned in slide "Can it work?... yes but...". (Will help to make AM work, to "institutionalise" AM)
- Tool (model) not used-process is important
- Flexibility in land management
- The start up process for AM- guidelines?
- Systems thinking linked to AM, from data to insights etc
- Closing the gap between informal adaptive management → insert to adaptive plan

Stakeholder engagement

- Emphasis on negotiation needed
- Building capacity/tolerance for surprise, mistake making
- Community capacity to play a role in AM- what role?
- How does the “Parkie” develop the capacity to engage in policy making?
- How does the general public engage/influence AM plans?
- What were the key elements for community engagement/participation in AM? Is it required?
- Can good process (community participation) undermine good NRM science? And who should “win”?
- What process do we use to select stakeholder representatives?
- Who determines who will be involved?
- Driver for participation: mutual self interest
- Concept of “sectors” and diversity within sectors
- What is “real” consultation?
- How many landholders use the internet?
- What are the problems of proposed policy? Ask the stakeholders before policy finalised, not explain difficulties after implementation
- Different folks might have different goals, but they can come to understand other positions
- ISKM: access local experience before accessing science data
- New community consultation processes need to be evolved
- Communication to constituencies. Structures process for community consultations. How do you manage conflicting interpretations of the science/data?
- “Mentoring” stakeholder groups to use the same discourse- “trade in the same currency”
- Educate managers in principles of adaptive management
- What is a “user friendly face”?
- How accepting of AM are “hard line” technical experts?
- What about when community values change- need on going community involvement
- Engagement does not equal consultation
- How do you keep the representatives of stakeholders connected to their constituencies?
- Taking knowledge without influence- disenfranchisement
- What is community or stakeholder interaction? It is explaining to the community or stakeholders what is our decided policy

Monitoring

- Need to evaluate in terms of outcomes
- Measure (what) to manage (adaptively)?
- Establishment of integrated monitoring networks
- Policies are experiments
- How do you “test” the value of AM?
- Strategies for linking monitoring with management

- How do implementation feed back into planning loops?
- What are ways of monitoring?
- Shifting evaluation from personal learning an understanding to corporate learning
- Getting the monitoring and feedback right
- Where does the review/evaluation go? Where's the feedback?

Uncertainty / Risk

- Risk averse: paralyze ability to experiment. Need to engage is equivalent to a risk
- Uncertainty should be welcomed- provides opportunities and need to have structures etc to be receptive to it, rather than avoiding / suppressing. To see uncertainty as a threat is consistent with command and control mindset and destine to failure
- Too much at stake to experiment
- Risk aversion: not only agencies also government, community, key stakeholders
- Uncertainty- don't know variables, probability. Need to engage with uncertainty
- How can we best support those managers willing to take a risk? – By doing AM
- The notion of “experiment” is problematic when seeking to argue the merits of AM
- How we conceive behaviour in relation to risk and uncertainty

Institutions

- Need regional organisations to be AM organisations
- What is an enabling institutional environment?
- What is an appropriate “enabling institution” ? How do you get it?
- Need institutions that facilitate negotiations between sectors
- What are optimal institutional arrangements? Can we define a “best practice” process or a body of work for reference?
- Need continuity of commitment
- Turf protection
- Can a bureaucracy engage in AM?
- Active AM cycle is nested within an operational adaptive cycle. If OAC not institutionalised, AAM not possible
- Issues of dealing with multiple jurisdictions
- Gaining political/ institutional support- what strategies?
- Complex institutional arrangements
- Ownership and resources to those implementing AM
- Lack of appropriate institutions- belief systems
- Institutionalise AM through an adaptive operational system

Scope

- Can we retrofit existing NRM plans (monitoring/knowledge/change loop) to be more adaptive?
- When is adaptive management not appropriate? Eg short time frame, risk of failure unacceptable, not have skills, likelihood of “success”
- Why more data? What criteria make it an AM project?
- AM won't work- problem is too large
- If AM can't handle complexity what use is it?
- If AM needs few stakeholders and jurisdictions what use is it? Very narrow application
- Why bother with Adaptive Management at all?
- Does adaptive management propose altered societal relations?
- Not “muddling through” but need to explore/explain what it involves
- Strategically select “projects” for applying AM
- What do we adapt- aspects of management
- Careful selection of ‘case studies’ What not to do? Favour the advantaged? Take over a “basket case”?
- Is the likely “success” of AM just a question of scale?
- What is this notion of place and how does it feature within AM. Re Tony Meppem

Requirements / leadership

- Need for government policy support, acceptance of uncertainty
- Appropriate corporate commitment
- Need leadership and clarity of vision
- Need to give AM time to work
- Appropriate timelines
- Need to treat the rhetoric seriously
- Need non compartmentalised organisations
- Need particular skills, processes and structures
- 1st step: getting the problem right
- Need credible and transparent science
- Getting political will/support for AM
- AM requires leadership to emphasise importance and get resources
- AM often requires a “champion”
- Need a champion in the system
- AM requires learning / skills. What type? How?
- Need good processes, good relationships, good outcomes
- Need for quant (performance indicator) non procedural objectives
- Need to recognize/separate slow and fast variables and manage accordingly. Also recognise what we can and cannot manage. If you can't don't measure you cannot manage.
- Need sectors to develop own planning and management capacity
- What resources do we need to make AM work?

- How to build capacity for sectors to contribute to negotiated regional solutions?
- Need everything to be in the AM process- no parallel processes

Principles

- Frank discussions of unpleasant facts → impetus for change
- Interface of communicators at all levels
- AM can be used where not much data
- Most aspects/components of AM are known but it's the combination of them that distinguishes AM
- Safety and security in rules – yet knowledge is provisional
- In AM you do not have reliance on the rules
- Emergent properties of working at large scales
- What are the key principles of AAM? Bruce nominated 7 points. Tony nominated 3 cornerstones. If we can get agreement it would help us realise what we have learnt
- AM is –stakeholders, learning/knowledge base, confronting uncertainty, monitoring, proposing/revising policy, focused research, local ownership
- Adaptive management vs muddling along. What's the real difference?
- Muddling along vs adaptive management
- Confusing AM with muddling through
- How can we best support those managers willing to take a risk?
- Champions

Objectives

- How do you work out objectives?
- Important to identify objectives even when they conflict or overlap
- How are targets set (30% 50% 70%) ?
- How to get agreement on objectives?
- Get the objectives right
- Identify the “Problem”
- Identify the problem, not the apparent issue
- Generalist to specific
- Way ahead- clear objectives, institutional security/support
- Working out objectives (Ref USEPA Ecological Risk assessment)
- What was the focus of Tony's Colorado River AM program? How did the process measure up to that? Aim?
- How can adaptive management approaches be used to implement shared and competing objectives?

Learning

- How do we integrate knowledge from different knowledge systems?
- How was the social/economic consequences determined? What type of survey?
- Is/does “knowledge” mean the same to each person?
- Resistance to formal learning- documentation, meaning?, modelling

- Who is learning- what role do the public play in AM?
- Learning: Means: ? : End
- Knowledge producers and knowledge users are one and the same
- What can we learn form other experiment/innovation in other spheres/places?
- Hypothesis setting to formalise learning- what level?
- Many ways of knowing the world- technical/ local/ experiment
- There are lots of ways of knowing the world
- Evolutionary: driven by new understanding
- Learning as a performance element
- When in doubt study
- How were these studies used? If at all

Models

- Value of conceptual models
- Extent rely on modelling to frame process?
- Can policies be developed rationally? How can models guide policy development?
- How can modelling be used effectively to help adaptive management?
- Models vs building models

Capacity building for practitioners

- Educate managers in the principles of adaptive management
- Building capacity/tolerance for surprise, mistake making... in institutions and stakeholders

Values

- Importance of value clarification / Value conflicts

WORKSHOP REFLECTION

The workshop concluded with the whole gathering reflecting on issues the workshop had raised. Each participant contributed a statement in turn about what was needed to improve the understanding or the outcomes of an adaptive management approach in Australia.

- Involve other people
- Capture this learning
- Produce a monitoring “cookbook”
- Develop iterative reporting
- Look harder at obstacles
- Develop strategies in detail using cases
- Peer support - this group
- Initiate network
- Use this information to add to current management
- Scaling up
- Document examples / case from Australia
- Resource material
- Think about adaptive management for institutions /organisations
- Computer aided conferencing
- Monitoring community learning

ACTIONS

Specific activities were identified as useful outcomes of the workshop (Table 1)

Action	Responsible people	Time
Produce workshop report	Catherine Allan	Draft September 2002 Distribution October 2002
A communiqué based on the workshop report be submitted to an appropriate Australian Journal	Catherine Allan, Allan Curtis and Michael Lockwood	November 2002
A paper looking at “what if it were done adaptively” to be developed. The central study of this is the NE Regional Catchment Strategy, with possibly the Murray Board’s blueprint also considered.	Lead people: Tony Ladson and Jeff Taylor, with support from Paul McGowan, Rex Candy, Bruce Mapstone, Tony Dawson, and Alistair Gilmour	January 2003
Compilation and description of Australian case studies	Hamish Cresswell, Rex Candy, Tony Ladson and Catherine Allan.	February 2003
Web conferencing and/or email list	Johnstone Centre, Charles Sturt University, Catherine Allan to follow up.	October 2002
Workshop 2003	Steering committee: Allan Curtis, Warwick McDonald, Alistair Gilmour, Ockie Bosch, Pat Feehan, Bruce Mapstone, and Catherine Allan.	Allan Curtis to chair a steering committee meeting in Canberra in December 2002.
Present adaptive management information to senior policy people		To be discussed at next workshop?

Table 1 Outcomes and tasks from the adaptive management workshop

AN ADAPTIVE MANAGEMENT BACKGROUND PAPER

Prepared for the adaptive management workshop, Lake Hume, July 24/25, 2002. Held in association with the 2002 Fenner Conference for the Environment

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Background

The term adaptive management was developed in the 1970s to describe an approach to natural resource management that consciously uses policy as an experiment to enable people to learn about systems as they manage them. It arose from within the ecosystem management discipline as part of an attempt to address perceived issues of scale, uncertainty and the limitations of reductionist science (Holling 1978).

Use of “adaptive management” over the last three decades has encompassed three separate understandings of the term, which have been described as evolutionary, passive and active (Walters & Holling 1990). *Evolutionary adaptive management* describes a popular understanding of adaptive management as merely learning from experience, or trial and error. *Passive adaptive management* is more directed. It uses lessons from history to develop a single best policy to apply in practice, and the consequences may eventually inform future decision making. Passive adaptive management is used often enough in natural resource management to suggest that it is the current “normal” approach. Most resource managers make informed guesses, which, with an added margin for error, become best management practices, to be modified in the light of failures or successes (Walters & Holling 1990). (Parma et al. 1998) Passive adaptive management is suitable for many situations, especially when single use or exploitation of a resource is the management goal.

Active adaptive management sets out to use policy and its implementation as tools for accelerated learning. Adaptive policy is designed to test clearly formulated hypotheses about the behaviour of a managed ecosystem (Lee 1993b). Management experiments may be designed which use planned spatial or temporal comparisons to test predictions about system behaviour (Walters & Green 1997). Data are used to develop a range of policy options, these options are tried and monitored, and management is modified in response to what is learned.

Active adaptive management, with its necessary move away from current normal practice, is the focus of the Lake Hume workshop, and the remainder of this paper.

The promise(s)

The rhetoric of adaptive management is now embraced by institutions worldwide. In Australia, it is claimed that most strategic planning processes use an adaptive management approach (Alexandra et al. 1998). At least one south east Australian project aimed at improving land use proudly proclaims its foundation in adaptive management (CSIRO 2000). Why is adaptive management welcomed so enthusiastically? What does it promise our natural resource managers and policy makers?

Adaptive management appears to provide a means for resource managers to keep managing in the face of uncertainty, and even to benefit from that uncertainty through the surprises that emerge from flexible experiments (Lee 1993b). In this respect, adaptive management is a pragmatic approach to the uncertainty that bedevils natural resource management (Norton 1999).

Because an adaptive approach aims to enhance learning, to remain flexible and look for “surprises”, Holling proposed it as part of the solution to twentieth century environmental crises and the “decision gridlock” generated by our dependence on ecosystems stripped of their resilience (Holling 1995). Johnson (1999a) echoes this sentiment, claiming that the overall goal of adaptive management is to develop optimum management within a range of acceptable outcomes while avoiding catastrophes.

Adaptive management also seems to provide an alternative to reductionist, laboratory style experiments which may only provide “spurious certitude” (Gunderson 1999a).

A less clearly articulated expectation, but one that is implicit in much of the literature, is that an adaptive approach necessarily encourages inclusiveness and participation, with an even less well articulated assumption that participation is always a “good thing”.

In short, adaptive management appears to promise to:

1. allow management to proceed in the face of uncertainty
2. accelerate learning about natural resource systems
3. help build flexible management capacity
4. be a large scale, holistic alternative to reductionist science
5. involve social and political values in ecosystem management in ways which other approaches cannot
6. enhance communication

Reality?

Despite almost three decades of theorising adaptive management is still more of a good idea than a proven practical approach to managing ecosystems (McLain & Lee 1996; Walters 1997; Lee 1999). Various reflections on adaptive management have been published. Of note for this paper are evaluations of the Adaptive Management Areas in the Pacific North West of the USA (Stankey & Shindler 1996; Shindler et al. 1999; Shindler & Cheek 1999; Stankey et al. 2001; Shindler et al. 1999; Clark et al. 1999; Stankey forthcoming), and lessons for Australian river management (Ladson & Argent 2002).

Lee (1993b) evoked an image of the compass and gyroscope to show the necessary interplay of science and society. This image provides a useful way of reviewing the literature on adaptive management, which seems to focus on experimentation on the one hand, and social learning on the other.

Ecosystem experiments

Most definitions of adaptive management stress its experimental nature. From this perspective adaptive management is a process which develops a hypothesis that links management actions to ecological outcomes (Hillman et al. 2000), and structures management to allow hypotheses to be posed and tested (Dovers & Mobbs 1997). Policy is thus 'questions masquerading as answers' (Gunderson 1999a, p.1). Management activities are not just modified as a result of new information; they are deliberately designed to increase understanding about the system being managed (Taylor et al. 1997). Adaptive management is structured to make learning from policy experiments explicit (Johnson 1999b) and efficient (Gunderson 1999b).

Modelling has historically been an important concept for adaptive management. Indeed, it has been said that integrating interdisciplinary experience and scientific information into predictive models is a *necessary first step* for adaptive management (Walters 1997). In an ecosystem management context models must reflect complex ecological and social environments, so multi-disciplinary, participatory approaches such as Adaptive Environmental Assessment and Management (AEAM) were developed. AEAM explicitly uses multi-discipline participation to construct models and hypothesis from a variety of learnings and experiences. These models are used to help managers choose management experiments to apply and evaluate (Ewing et al. 1998). Examples of AEAM come from the Blackwood Catchment in Western Australia (Ewing et al. 2000), the urban fringe water cycle (Gilmour 1999) and the La Trobe River catchment (Grayson et al. 1994).

Some documented examples of adaptive management appear to see modelling as an endpoint, with a focus on collecting sufficient data for the model, or the map. Data collection and modelling can be mistaken for learning, when really they are just preparation for it (Lee 1999).

The other technical focus associated with adaptive management is BIG science. Some environmental management issues are too complex, involve so many disciplines and contain too many uncertainties for reductionist approaches, so large scale field experiments - 'management experiments' - become attractive. Examples come from the Everglades (Walters & Holling 1990) and the Great Barrier Reef (Mapstone et al. 1996).

Social Learning

The science involved in adaptive management is not new, yet active adaptive management is a radical departure from the way natural resources have been managed to date. This is partly because a broader range of people are being asked to be involved in learning about and understanding ecosystems. Social and political involvement is not only desirable, but necessary if management is to do more than just avoid the negative externalities of the development process (Lee 1993a; Roe 1996; Woodhill & Roling 1998; Miller 1999). Adaptive management of ecosystems involves a recognition that human society and behaviours are part of, rather than outside, the ecosystem, demanding a multifaceted response (Holling & Meffe 1996).

Science won't happen without the social and political input (Lee 1993b). Politics, ethics and societal values determine whether a problem is important, which activities are considered "baseline", and what treatment options can be involved (Roe 1996; Walters & Green 1997; Lee 1999). AEAM overtly seeks to include community values by involving multidisciplinary stakeholder participation through modelling workshops (Ewing et al. 1998).

Improving the ways in which communities manage share and use information about their natural resources is as important to adaptive management as the validity and appropriateness of the science employed. By acknowledging different ways of knowing adaptive management may facilitate a move toward more active research, incorporating the investigators within the system being studied (Bawden 1991). Evaluation and reflection become important management activities at both project and institutional scales (Bellamy et al. 2001) (Dovers 1996). Adaptive management precipitates a need for better information management to facilitate social learning. Approaches such as Integrated Systems for Knowledge Management (ISKM), build on principles of systems thinking and "learning by doing" (Allen et al. 1999).

Adaptive management has also been seen as a vehicle for communication, at both micro and macro scales. The participatory nature of AEAM modelling suggests an opportunity for scientists to communicate technical ideas through understandable and reality based modelling (Haney & Power 1996). More ambitiously, adaptive management is seen as a possible framework for providing communication links between ecology, policy process and institutions/people (Dovers & Mobbs 1997) and for policy formulation, negotiation and evaluation (Gilmour 1999).

Adaptive management has developed around a number of different resource loci, mostly in the United States, notably forest, fisheries and river basin management. An excellent and comprehensive annotated bibliography is based around these resource types (Tsegaye Nega 2000). Information on the practice of managing adaptively is also available via the (US based) Adaptive Management Practitioners Network (AMPN 2002).

When should adaptive management be attempted? Adaptive management is not intrinsically "better" than other management approaches. Where variables are well understood, or the problem tightly bounded, traditional forms of management may be cheaper and less risky (Walters & Green 1997). For more complex, less certain situations, however, even passive adaptive approaches will inevitably face variation over time, from which much could be learned (Walters & Hilborn 1978).

It should also be recognised that adaptive approaches do not necessarily lead to more sustainable outcomes. Adaptive management is just a process that may provide more and better information to decision makers (Dovers & Mobbs 1997).

The Lake Hume workshop aims to put some shape to this process, to flesh it in ways which will help us all improve the way our natural resources are managed.

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