Active Adaptive Management

Enhancing the integration of science and management to improve delivery of conservation and land management outcomes

A Discussion Paper

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Introduction

Since the 1990s, developed nations have experienced a major shift in cultural values. This has led to the questioning of whether science has an undeserved privileged position in shaping society. People tend to be less trusting of experts and authority figures. This has exaggerated the disadvantages of scientific knowledge by emphasizing the uncertainty and provisional basis of knowledge.

Institutions have also begun to adapt to these cultural shifts by embracing precaution, uncertainty and risk assessment in strategic planning. Agencies such as CALM now explicitly position themselves as a science-based, learning organizations i.e. recognizing that ecological knowledge will always be incomplete and provisional and often place-specific (and not generalizable with confidence).

A key role for science and for the Science Division within CALM is to provide the knowledge and understanding of biodiversity and ecosystem processes to inform policy and planning and to underpin implementation, monitoring and evaluation. The Division has generated knowledge through a variety of mechanisms and processes, including survey, laboratory and field experimentation, the scientific literature and deduction. The way we do business is summarized in the Science Division's 2004-2006 Business Plan. In essence, the Division, although administratively centralized, is not restricted to specific geographical or regional administrative boundaries, but instead attempts to provide a State-wide coverage. Western Australia is about one third of the Australian continent with the commensurate level of biodiversity and environmental issues and CALM's Science Division represents the State's major investment in terrestrial biodiversity conservation research. By desire and design, much of the research undertaken by the Division has broad application across administrative and biogeographical boundaries. Provided these activities are aligned with corporate priorities, this is a cost-effective way of delivering science and information. To attempt to duplicate research effort in each of CALM's administrative regions, or to fully regionalize science, is both unnecessarily wasteful and unachievable with existing resources.

Better integration of science and scientists into regional nature conservation and sustainable forest management programs that are a high priority for the Department is highly desirable for achieving conservation and land management outcomes. There are too few scientists in the Division to engage in this process for all projects in all nine CALM regions, so a formal risk analysis process is needed to identify regional priorities, and from this, Departmental priorities at the project level. Similarly, regional resources are stretched so regions, and the Department, need to be more strategic and smarter about devising and implementing management actions through the development of Regional Nature Conservation Plans.

The Science Division can best serve CALM and conservation in Western Australia by carrying out a balance of a) biological survey and inventory b) experimental research to find solutions to problems of a broad biogeographical nature, c) focused research on specific high priority species,

communities and processes, and d) working as part of regional operations project teams to plan and implement management programs in an active adaptive management framework.

While there exists a level of collaboration between the Science Division and regions at the project level, there is an increasing requirement by the regions and by the primary Output Programs to further develop and expand this approach in order to meet growing challenges in conservation and land management. Major benefits to the region of greater collaboration with Science Division include enhanced access to planning and technical skills and to scientific knowledge, greater capacity to implement science-based management actions and (technical) upskilling of regional staff. Done in an adaptive management framework, this approach can also build knowledge and understanding of ecosystem processes resulting in better, more cost-effective conservation and land management outcomes.

The concept of adaptive management was formalized in the 1970s but struggled to gain broad acceptance perhaps because the certainty inherent in the physical and chemical sciences was regarded as the standard to which ecological science should aspire. However, over the last decade adaptive management as a concept or policy innovation has become increasingly prevalent and accepted in natural resource management policy and planning. It is usually presented as an idea, or a notion, but there are few examples in the literature where the approach is applied in a practical manner for delivering conservation outcomes and advancing knowledge.

While the adaptive management approach outlined here can be applied to many of CALM's operations, this discussion paper intentionally focuses on the role of the Science Division in such an approach. It explores a practical approach to adaptive management by proposing a framework that better integrates and utilizes the resources and skills of the Science Division to deliver conservation and land management outcomes that have been identified by corporate priority setting processes. I am suggesting an incremental process that identifies specific priority projects likely to benefit from an adaptive management approach.

Some Definitions of Adaptive Management

The following is a variety of (unreferenced) definitions of adaptive management gleaned from an internet (Google) search. While the wording varies, the definitions have similar basic ingredients of uncertainty of knowledge, learning by doing, treating management activities as a *quasi*-experiments and monitoring.

"*Adaptive management is a **process** for implementing policy decisions as an **ongoing activity** that requires monitoring and adjustment. Adaptive management **applies scientific principles and methods to improve resource management incrementally** as managers **learn from experience** and as new scientific findings and social changes demand."*

"*Adaptive management is a **systematic process** for **continually improving** management policies and practices by **learning from the outcomes of operational programs**. Its most effective form–"**active**" adaptive management–employs management programs that are **designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses** about the system being managed.*

"*Adaptive management is an **integrated approach** to **acknowledging and reducing uncertainty** in natural resource management through a process **linking science, values, management, experience,** and **decision making**. Active adaptive management "…employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed." In **treating policies as experiments** and **actively designing feedback loops into future decision** making processes, active adaptive management is designed to **speed learning**, to **surface and challenge old models and beliefs**, and to **create new understandings and behaviors**, leading to **better management** and **increased trust**".*

"*Adaptive management is a **formal process** that **involves science, agencies and citizens** in management and **provides civil learning opportunities for all**. Adaptive management is learning-by-doing, and then using the results of management trials to affect public policy decision making. It is literally and figuratively **playing with ideas, trying something based on the best science available just to see if it works, experimenting with new management techniques** but with an explicit **commitment to effectively monitor their outcomes and adjust management** actions as needed"*.

"*Adaptive management incorporates research into conservation action. Specifically, it is the **integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn***".

"*Adaptive management is **a process for developing hypotheses** about how components of an ecosystem function and interact, and for using management actions **at a large scale** to test those hypotheses and **to learn** more about our **management options**. It is **designed to create opportunity to use our greatest creativity in solving problems while managing the risks, to learn as we go**, and to **incorporate new knowledge** into subsequent steps. It is different from 'muddling through," however, in that it inherently presumes pre-experiment design and follow-up monitoring are needed in order to evaluate whether management has accomplished what is intended, and if outcomes are consistent with our understanding of ecosystem structure and function"*.

"*Adaptive management **treats management policies and actions as experiments** in order to **improve management by learning** from the ecosystems being affected. Adaptive management **links credible science, values, and experience of stakeholders and managers for management decision making***".

"*Adaptive management is an approach to natural resource policy that embodies a simple imperative: **polices are experiments; learn from them**...Adaptive management **takes uncertainty seriously**, treating human interventions in natural ecosystems as experimental probes. Its practitioners **take special care with information**. First, they are **explicit about what they expect**, so that they can design methods and apparatus to make measurements. Second, **they collect and analyze information so that expectations can be compared with actuality**. Finally, they **transform comparison into learning** — they **correct errors, improve their imperfect understanding**, and **change action and plans**. Linking science and human purpose, adaptive management **serves as a compass** for us to use in searching for a sustainable future*".

"*Under adaptive management, **reducing uncertainty becomes an objective of management, and policies are treated as experiments**. The ecological effects of management are **monitored, and policies are adapted** depending on observations. Adaptive management has the added benefit of integrating science and resource management, ensuring applied science is well directed and scientific advances are transferred to managers*".

Active Adaptive Management (AAM)

Active Adaptive Management (AAM) is a form of adaptive management that treats management actions as '*quasi* experiments'. As such, it is recognized that the measured outcomes may have greater variability than controlled, properly replicated experiments. In the CALM context, it is a process whereby scientists work in collaboration or partnership with regional staff on conservation and land management programs that have been identified as a priority through corporate priority setting processes (e.g., the strategic regional planning and budget process, various management plans etc.). At its core, AAM involves the integration of design, management (implementation) and monitoring to systematically test assumptions in order to adapt and learn.

A project team including staff from Science Division, Regional Services, nature Conservation and perhaps other divisions of CALM where appropriate should implement the adaptive management cycle described below. A key, senior regional officer, such as the Regional Leader Nature Conservation or the Regional Ecologist, should lead the project team. AAM is not about carrying out research at the expense of regional resources; it is about a collaborative, scientifically-based implementation and learning approach to solving management problems. In addition to tangible conservation outcomes, an important outcome of this process is empowerment and learning for all involved, further enhancing the knowledge base and expertise of the Department.

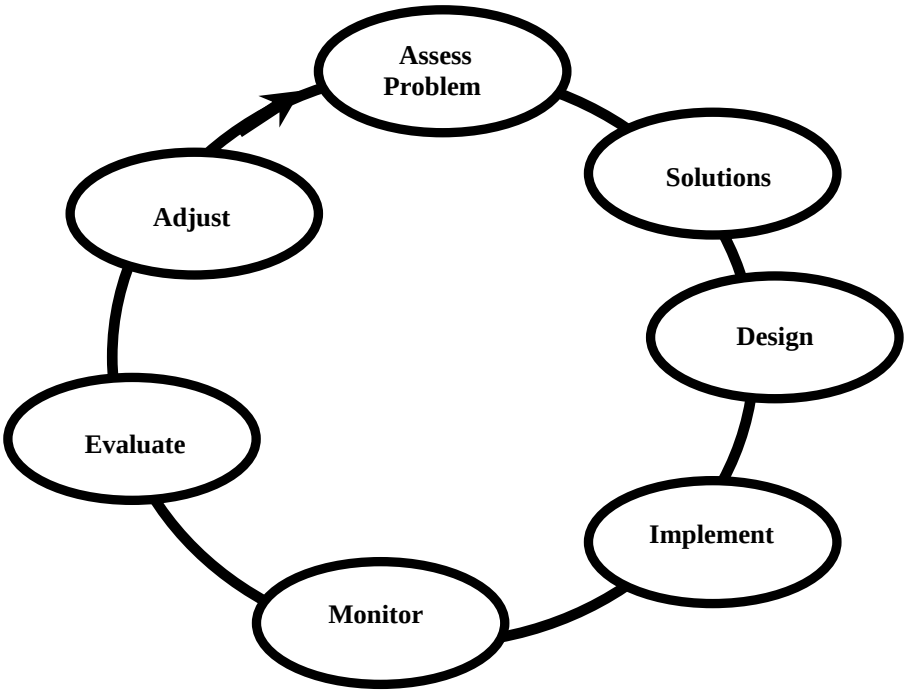
While it may not have been recognized as such at the time, there are a many examples where the Science Division and staff from other divisions have collaborated to apply versions of an active adaptive management approach to problem solving and delivering conservation and land management outcomes. A selection of these projects includes aerial prescribed burning in south-west forests in the 1960s, the first translocation of woylies from south Perup to north Perup in the mid-1970s, a fire regime for managing tammar habitat in Perup forest in the early 1980s, the Western Shield initiative, a number of threatened mammal and bird translocations (e.g. numbat, chuditch, western ringtail possum, Gilbert's Potoroo, dibbler, noisy scrub bird etc.), silvicultural systems for forest management, phosphite spraying for protecting plants against Phytophthora, threatened flora translocations, fire regimes for conserving mainland quokkas in the southern forests, controlling introduced predators in the arid zone at Lorna Glen, and implementing a diverse fire mosaic in the Walpole area to promote biodiversity and protect life and property.

In a conservation project context, active adaptive management is about systematically trying different actions to achieve a desired outcome. It is not, however, a random trial-and-error process. Having identified regional and corporate priority projects that are aligned with strategic priorities, the active adaptive management cycle involves at least 7 steps:

1. Problem assessment
2. Possible solutions
3. Design
4. Implementation
5. Monitoring
6. Evaluation
7. Adjustment

The framework formed by these 7 steps is intended to encourage a thoughtful, disciplined approach to management, without constraining the creativity that is vital to dealing effectively with uncertainty and change. The details of how the steps are applied and the level of rigour used depends on the scale of the problem/project and on the imagination of participants. This is intended to provide direction, stimulate thought and augment discussion. The proposal is that appropriate Science Division staff will participate in and contribute to the process at each stage.

Figure 1: Framework for Active Adaptive Management (AAM)



Step 1 - Assess the problem: The 'problem' in this context could be any specific and high priority issue requiring a management response to deliver conservation and land management outcomes. It could include various management actions and programs, such as specific threat amelioration to protect biodiversity or other values (e.g., fire, feral, weed, disease management), habitat management, translocations, biological survey, threatened species and communities recovery, silvicultural systems or restoration actions. Problem assessment can be accomplished via facilitated workshops or small meetings or one-on-one discussions, depending on the scale and complexity of the problem. At this stage, the nature and scope of the problem is clearly defined and management objectives specified, existing knowledge about the system/process is synthesized.

Step 2 - Devise possible solutions: Potential alternative hypotheses and management actions and their outcomes are explored. Explicit forecasts are made about outcomes in order to assess which actions are most likely to meet management objectives (scenario analysis). During this exploration and forecasting process, critical gaps in understanding/knowledge of the system/process (i.e., those that limit the ability to predict outcomes) are identified.

Step 3 - Design the project: This involves designing a detailed management action plan, including a monitoring program, that will guide what actions are to be taken, when, where, how and by whom, budget and other resource needs etc. Importantly, the plan must also be designed to provide reliable feedback about the effectiveness of the chosen actions (monitoring), including what information/data needs to be collected and how it will be stored and analyzed. Ideally, the plan should also be designed to yield information that will fill the critical gaps in understanding identified in Step 1. It is essential to evaluate one or more proposed plans or scenarios devised in Step 2 on the basis of costs, risks (environmental, economic, social, political), outcomes expected (benefits), the value of information gained and the ability/likelihood of the plan to meet management objectives.

In Step 4 - Implement the project: The plan is resourced and put into practice with the appropriate supervision (the plan is actioned).

Step 5 – Monitor the responses: Appropriate parameters or indicators are monitored/measured to determine how effective actions are in meeting management objectives, and to test the hypothesised relationships that formed the basis for the forecasts. Monitoring needs to be aimed at the threats and the values (i.e. outputs and outcomes) and linked to what was done on-ground (what method employed and resources committed) so that not only effectiveness can be evaluated, but also efficiency.

Step 6 - Evaluate and document: This involves comparing the actual outcomes based on the monitoring above to forecasts, and interpreting the reasons underlying any differences. Document, report and communicate findings.

Step 7 – Adjust: Policies, practices, objectives, and the models used to make forecasts are adjusted (if necessary) to reflect new understanding. Changes may involve small refinements or a shift in paradigm. Understanding gained in each of these 7 steps may lead to reassessment of the problem, new questions, and new options to try in a continual cycle of improvement.

In reality, some of the steps outlined will overlap, some will have to be revisited or some may be better done in more detail than others, depending on the size and complexity of the project. All steps should be planned in advance, though it may be necessary to modify them later. All 7 steps are essential to adaptive management; omission of one or more will hamper the ability to learn from management actions. In addition, documenting the key elements of each step, and communicating results are crucial to building a 'legacy of knowledge', especially for projects that extend over a long time. Developing information management systems at the regional level will facilitate this.

Examples of projects that lend themselves to collaborative adaptive experimental management:

- Introducing fire into the landscape to promote/protect biodiversity generally or to protect/manage specific species or communities.
- Spraying weeds with herbicides (to reduce competition with native plant species)
- Poison/baiting feral animals (foxes, cats, pigs, etc).
- Trapping/shooting of feral animals (camels, cattle, pigs, goats etc).
- Applying phosphite to Phytophthora-sensitive plant species (by injection or by aerial spraying).
- Surveying.
- Fencing (usually to exclude grazing or browsing mammals, native and introduced)
- Closing artificial water points (to reduce numbers of feral mammals reliant on access to artificial supplies of water).
- Rehabilitating degraded sites on CALM-managed estate (ameliorating compacted soil, revegetation).
- Translocating threatened fauna and flora species.
- Marooning threatened species on islands.

Other important elements of Active Adaptive Management (AAM)

Active adaptive management acknowledges and confronts uncertainty and acknowledges the need for long-term commitments to monitoring. Management decisions are treated as provisional experiments subject to verification or amendment.

A process for determining corporate and regional priorities at the project level is fundamental to decision making about resource allocations. This discussion paper also aims to improve integration of Science Division and Regional Services to deliver conservation and land

management outcomes at the project level, so regional ownership will be critical to successful outcomes.

Developing a vision:

- What will the ecosystem look like if the adaptive experimental management program is successful? This relies on having clear objectives for management - the vision and criteria for success would then be related to these objectives.
- Consideration of a full range of alternatives; constraints are not automatically accepted as given.

Forming project teams to implement adaptive experimental management needs to address:

- Resourcing and budgets.
- Who should be involved internally and externally (collaborators)?
- Roles and responsibilities.
- Relationship with organisational structures.
- Communication and sustaining the collaborative process.
- Data/information management.
- Community consultation.

Organizing knowledge:

- Integration of multidisciplinary information/knowledge.
- Conceptual modeling and assessment: Identification of key variables and ecosystem drivers.
- Development of core adaptive management experiment(s), considering alternatives, and incorporating the precautionary principle.
- Development of essential, relevant monitoring and research.

Monitoring consistently and adapting to feedback:

- Adjustment of management as a result of monitoring feedback - this could prove to be challenging where it requires a paradigm shift.
- Adjustment of monitoring if management experiment(s) is changed.
- Possible adjustment of vision/objectives.

Next Steps in AAM

Moving CALM, including the Science Division, towards greater involvement in an AAM approach will need to be a measured, incremental process. The rate of progress will be largely determined by a) willingness of staff to embrace this approach, including a commitment from Directors and Regional Managers, and b) the rate at which resources tied up in existing projects (both research and operational) can be mobilised or assimilated as AAM projects. There is likely to be a number of regional operations already underway that can be revised to fit the AAM framework with little or no additional cost.

By end of May 2005: This discussion paper will be circulated for input from the Science Management Team and through the Team, Science Division staff, and a final paper prepared and distributed to Regional Managers for comment. Paper will be edited based on feedback
By end of July 2005: The Science Director will present the paper to the Corporate Executive for comment/endorsement. Paper will be edited where necessary.
By end of September 2005: If the proposal is endorsed by the Corporate Executive**,** the Science Director will visit each region with the relevant regional science liaison officer to discuss the AAM approach with Regional Managers and key regional staff, and to identify potential AAM projects (either existing or new projects) that have been identified as a priority through corporate priority setting processes.
By end of October 2005: Finalise AAM projects and participants and prepare budgets in time for the 2006/07 budget cycle (Corporate Strategic Planning and Budget process).

Conclusion

In the foreseeable future, the Science Division will need to retain a capacity to carry out core activities including systematic biological surveys, applied research that has broad rather than local or regional application and threatened species and communities specific research. In addition, the Science Division has an opportunity to further integrate its activities with regional projects to deliver tangible management outcomes and to advance knowledge. An active adaptive management approach is a framework for doing this, but this is contingent on a corporate process for identifying projects that are a high priority to CALM and on a willingness of the agency to embrace and support this approach.

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