

Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
August 24-25, 2010

Agenda Item

Science and Management Presentation and Discussion

Action Requested

Please see below for the recommendations from the Science Advisors.

Presenter

David Garrett, Executive Coordinator, Science Advisors

Lance Gunderson, AMP Science Advisor, Professor, Environmental Studies, Emory University

Previous Action Taken

J By TWG: In order to build a common understanding of what other adaptive management programs from around the country have done in moving from Science to Management Actions, TWG made the following request to the Science Advisors via a motion in March 2009 that passed on a vote of 11-3, 2 abstaining:

The TWG requests that the Science Advisors develop a report on Management Actions from other programs which describe the transition from research to management. This should be developed in coordination with the TWG Chair, TWG Co-Chair, and Chief of GCMRC. The report should be provided to the TWG at its next meeting and a presentation should be provided. The SAs should also be available to present this to AMWG at their late summer meeting (likely in August).

This request would provide a place for the TWG to start in understanding the technical arguments and considerations of management actions and that further work would need to be done. TWG felt that given the current budget implications, it was necessary to begin work in order to inform the budget discussion. TWG has no experts in this area and thus asked the Science Advisors for support in this limited capacity. As part of the second motion passed by consensus on this subject, detailed below, TWG requests that AMWG (a) consider the topic of Management Actions and (b) request TWG to further consider the technical aspects of making these decisions, as well as potentially participating in the policy discussions, as appropriate.

The TWG requests that AMWG consider the policy implications of management actions. This could look similar to an in-and-out committee, involving interested parties that are familiar with the legal and policy framework of the program. This could either be a TWG or AMWG committee and could involve a mix of individuals from all parts of the AMP. We are looking to AMWG for guidance on how to, and if we should, further pursue the question of management actions.

J By AMWG: At its September 2009 meeting, AMWG passed the following motion by consensus:

The AMWG requests that the Science Advisors survey other adaptive management programs and develop a report which describes their definitions of criteria for defining science-based management actions and the transition from research to management. The report should be provided to the TWG and AMWG members, and TWG should review the report and forward to AMWG options for AMWG to consider with regard to how GCDAMP should handle these issues.

J By TWG: At its June 2010 meeting, TWG passed the following change to the proposed FY11-12 budget by a vote of 13-2 with 4 abstentions:

(line 171) Add \$20,000 to the SA budget in FY11 and FY12, to restore funding. Funding would be taken from line 165 (Admin. support).

While the purpose of the \$20,000 was not specified in the motion, the discussion indicated that the purpose was to be to support the development of improved decision-making processes for the AMP.

Relevant Science

√ N/A

Background Information

Please see attached the Executive Summary of the report from the Science Advisors, *Evaluation Of Criteria Guiding Transition Of Science And Management Actions In Adaptive Management Programs*. The full report can be found at http://www.usbr.gov/uc/rm/amp/twg/mtgs/10jun29/Attach_07c.pdf.

Science Advisors' Executive Coordinator Dave Garrett and Science Advisor Lance Gunderson will present an overview of the research completed on this project and their recommendations. General conclusions and recommendations are presented in the Executive Summary (attached).

**EVALUATION OF CRITERIA GUIDING
TRANSITION OF SCIENCE AND MANAGEMENT
ACTIONS IN ADAPTIVE MANAGEMENT PROGRAMS**

**BY
GCDAMP SCIENCE ADVISORS**

JUNE 2010

EXECUTIVE SUMMARY

EVALUATION OF CRITERIA GUIDING TRANSITIONS OF SCIENCE AND MANAGEMENT ACTIONS IN ADAPTIVE MANAGEMENT PROGRAMS

BY
GCDAMP SCIENCE ADVISORS
JUNE, 2010

THE ISSUE

The Glen Canyon Dam Adaptive Management Program (GCDAMP) continues to define implementation of adaptive management (AM) in terms of blending research, monitoring, management actions, etc. in policy experiments directed at managing complex resource issues of the middle Colorado River. In developing the FY 2010-11 work plans and budgets, GCDAMP members desired greater clarification of how adaptive management programs integrate experiments and policy and how they distinguish and transition between science and management responsibilities and funding.

A GCDAMP project that gave impetus to the need for greater clarification in the above areas is the mechanical non-native fish removal program along the river mainstem. The non-native fish removal program was established as a policy experiment to determine if non-native fish and specifically rainbow trout could be effectively removed from the ecosystem. Based on the hypothesis that rainbow trout created negative impacts to the Humpback Chub population, effective removal procedures were developed and included in a 2008 Biological Opinion issued by the US Fish and Wildlife Service as a necessary conservation measure to be implemented by the GCDAMP. Under current budgeting guidelines used by the GCDAMP science and management actions are considered as separable funding items. Hence, the administrative issue arose as to how coldwater species control (specifically non-native salmonids) should be managed and funded. That is, should this project be continued and funded as a policy experiment of the GCDAMP and managed by the Grand Canyon Monitoring and Research center (GCMRC)? Or, should it be redefined as a management or compliance activity by one or more management agencies and overseen and funded by the agencies apart from the GCDAMP?

SCIENCE ADVISOR CHARGE AND PROCEDURE

In response to these questions, the Adaptive Management Work Group (AMWG) passed the following motion by consensus on August 13, 2009 reflecting their desire to have the GCDAMP Science Advisors (SAs) continue to develop information on this issue:

"The AMWG requests that the Science Advisors survey other adaptive management programs and develop a report which describes their definitions of criteria for defining science-based management actions and the transition from research to management. The report should be provided to the TWG and AMWG members, and TWG should review the

report and forward to AMWG options for AMWG to consider with regard to how GCDAMP should handle these issues.”

The Science Advisors responded to the AMWG’s request by doing a brief review of literature as well as evaluations of how other AM programs manage transitions from science inquiry to management actions or similar practices on specific issues, projects or activities. Based on this information, criteria and guidelines were identified to assist scientists, managers and stakeholders improve transitions of science and management actions in the GCDAMP process.

PERSPECTIVES FROM LITERATURE ON MANAGEMENT ACTIONS, POLICY AND SCIENCE IN AM

Two key ideas surfaced from the review of adaptive management literature and AM programs that relate to the issue of programmatic transitions between science and management activities in AM programs. First, most often there are not clear distinctions made between science and management in AM programs. Second, the pursuit of social or institutional learning is but one linkage between research and management in an adaptive management program. Both ideas have implications for decisions about management and science authorities and responsibilities, as well as funding allocations.

Adaptive management is not designed as a science process with a primary goal to reduce uncertainty relating to proposed policy and management actions so they can be implemented. Nor is it simply a management model that determines best management actions to meet policy objectives. Rather, adaptive management is a blend of the two, one that generates opportunity for learning how to understand complex ecosystems, while achieving resource improvement goals. Conceptual models of adaptive management characterize the AM process as more a continuum of using science to evaluate outcomes of adjusted management policies/actions due to changing biological and social dynamics as well as surprises. Uncertainty and risk are embraced as significant continuous elements of the process. As such, the adaptive management paradigm addresses learning differently than the more traditional science model of extensive science applications to reduce uncertainty and risk before management action is taken.

Guidance from the AM literature would support several general clarifications regarding the AM paradigm and the relative role of science and management actions in these programs as follows.

- AM programs in natural resource conservation are management models established to resolve complex, multiple resource issues that harbor significant ongoing uncertainty.
- Active AM programs are most effective in implementing iterative management actions and monitoring through time to create improved states of resource conditions and learning.
- Two types of learning are involved in the AM model. The first, “single loop”, uses monitoring to evaluate the effectiveness of selected management actions as policy experiments, but assumes that the underlying AM hypotheses regarding attainment of resource goals is correct. The second, “double loop” learning allows for the development and replacement of hypotheses over time. That is changes in all processes of the AM model can occur.

The ever-present uncertainty in AM programs requires, as noted, a different purpose for management actions and ordering of the actions by managers. The AM model must rely also on a broader and also slightly different set of criteria for evaluating outcomes from differing

management actions. These include probability analysis, uncertainty analysis, stochastic modeling, social consensus, resource tradeoff analysis, structured decision processes, etc.

In terms of the salmonid mechanical harvest program, this program is still viewed in terms of a hypothesis among multiple hypothesis that through learning are likely to help meet humpback chub recovery goals. As such, it is one of a variety of interactive management actions and monitoring activities needed, but one that should help managers continue to learn how to meet these goals.

The review revealed that AM structures and processes used by the GCDAMP and other AM programs do effect transitions between management and science. Many AM program attributes have some influence on these transitions.

OBSERVATIONS ON GCDAMP STRUCTURE AND PROCESSES AND IMPLICATIONS TO PROGRAMMATIC TRANSITIONS

The programmatic transitions among various stages of an AM program, i.e., consensus building, assessments, management actions, monitoring, evaluation, revised management actions, etc., represent a continuum of decision points for managers. Developed criteria associated with the following institutional structures and characteristics of the GCDAMP are helpful in understanding both impediments and supporting mechanisms to science and management transitions.

- Organization, Goals and leadership
- Program and budget planning
- Effective science monitoring
- Responding to external perturbations
- Assessments of Knowledge
- Independent Reviews

Organization, Goals and Leadership

The GCDAMP program has defined purpose, mission, strategies, goals, etc, that are supported by federal law, regulation, policy and funding mechanisms. It has an organizational structure similar to most AM programs. The ability to operate multiple major management activities concurrently while maintaining resources and learning is general evidence that transitioning of management actions to monitoring and back to management actions is realizing selected successes.

However, several reviews of the GCDAMP program over the past five years have identified needs of the program to reevaluate several of its adaptive management processes related to administrative structure, roles of the GCDAMP groups, desired future conditions, monitoring plans, Native American consultation, etc., as well as others areas. Reviews and revisions in some criteria and guidelines could improve transitions between management actions and science, such as the following.

- A review of overall mission and goals needs to occur, such as those relating to criteria guiding the GCDAMP role for overall resource management and recovery of T&E species
- The roles and responsibilities of the GCDAMP groups need to be reevaluated and possibly revised.
- Development of more specific goals and well defined desired future conditions needs accomplishment

Program Planning and Budgeting

In recent planning direction, i.e., 2004-2010, strategic and operational program and budget plans are in place and utilized. Evidence exists that the program, after 15 years of operation, could benefit from the "Double Loop" learning process.

Continued budget shortfalls in areas that were determined to be important management actions and monitoring reveals either needed improvements in program planning criteria for determining the minimal information that is explicitly needed, and more effective out year budget planning.

Effective Science Monitoring

The AM model uses monitoring of the resource impacts of management actions to validate both accomplishment of resource improvement and learning. In the second decade of the GCDAMP, 2007-2016 it is proposed that core monitoring programs will formally be implemented for each GCDAMP goal. Implementation proposals for this critical program require longer term planning, programming and budgeting commitments by all AMP entities. Concern exists that criteria such as fully specified goals, information needs, and budgets need better planning. Focus is needed regarding the minimal information needs that best inform management actions and science and improve resources.

Responding to Perturbations

An attribute of many AM programs with high variability is that one can be surprised by perturbations that were not foreseen. The GCDAMP has witnessed several in its short tenure.

The issue of warm water releases from Glen Canyon Dam, one such perturbation, did result in some disruptions of management and science processes during the 2003-2006 period, but it was minimal. However, although GCMRC and TWG both identified needs for potential management and science changes and additions to the GCDAMP portfolio as a result of this perturbation, only minor changes appear to have occurred. For example, should improved or changed criteria and assessment guidelines related to warming been a response to this perturbation?

Assessments of Knowledge

The GCDAMP program with GCMRC guidance has recommended criteria for significant reviews of knowledge at five-year intervals, i.e. Knowledge Assessment and Status of Colorado River Ecosystem (SCORE) reports. To maintain effective policy on transitions of management and science these assessments should also be developed to inform redesign of management actions and science programs.

Independent Review

Internal and external review processes are critical criteria for evaluating an organizations effective use of management and science to address issues. Reviews have cited needs for many improvements including greater ecosystem focus of the GCDAMP, improved integration of science and management activities, appropriate role assignments of entities, desired future conditions etc.

How a collaborative AM program structures independent review and responds to it can significantly influence, through time, the effectiveness of management and science transitions.

OBSERVATIONS FROM REVIEWED AM PROGRAMS

Ten currently active CAM Programs were reviewed to evaluate criteria they use in sustaining effective transitions of management and science in the AM process, and how those criteria and approaches might benefit the GCDAMP.

The review confirmed the literature assessment that active CAM Programs have developed criteria and guidelines in AM processes to assist these transitions. Our review first looked at improvements needed in GCDAMP processes and then evaluated other AM programs for criteria that would assist the GCDAMP in making improvements.

The need for several improvements were identified in GCDAMP processes. The following were focused upon in reviewing other AM programs.

- Organization structure, goals, dfcs; etc.
- Program planning and budgeting
- Effective monitoring programs
- Responding to perturbations

Reviews of other AM programs reveal broad opportunities to transfer knowledge gained on management actions and science to assist the GCDAMP. These include fish management and monitoring approaches used in The Upper Colorado, San Juan River and Platte River RIPs; First Nation consensus building and dispute resolution in the Lower Bridge River; AM processes for program planning and budgeting from the CAL-FED ERP and Kissimmee River RP; analytical tradeoff models and decision support systems from CAL-FED ERP, Lower Bridge River, Lincoln National Forest Restoration Program; etc.

CONCLUSIONS

Findings from this assessment were used to craft the following conclusions and recommendations.

- AM is not science departs from the traditional science model wherein science is implemented until uncertainty is primarily resolved and management actions can be implemented with limited risk.
- AM development was necessary to confront the dynamics and continued uncertainties and risks encountered in large natural resource management issues such as riverine restoration, native species recovery, large forest area restoration, etc.
- AM processes engage broad based stakeholder concerns, use best knowledge to define policy experiments and needed management actions to improve resources and learn, monitor and evaluate outcomes of these actions, and modify actions through repeated cycles of management and monitoring to gain desired outcomes.
- Two general statements often ascribed to the AM model are very appropriate, “you learn by doing”, and “distinctions between management and science are blurred in the process to accomplish the primary goal, resource improvement”.
- Because the management model relies on best science and modeling to both learn and define and refine improved management actions through repeated cycles, it is critical that managers are attentive to maintaining robust AM processes that will maximize effectiveness and efficiencies in continued transitions of management and science activities.

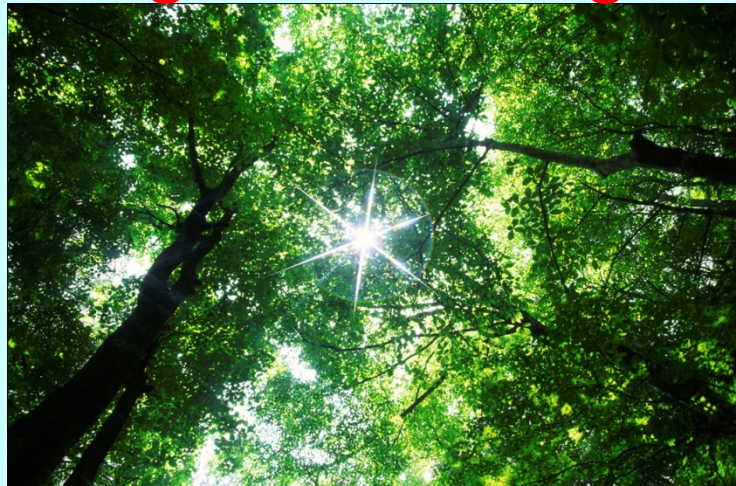
- Reviews of literature and operating AM programs reveal that several AM attributes and processes are critical to sustaining effective management/science processes through time. Reviews of the GCDAMP indicates that improvements may be needed in several of those AM processes including:
 - GCDAMP organization and structure
 - Program planning and budgeting
 - Effective monitoring approaches
 - Responding to perturbations
- Reviews of other AM programs reveal broad opportunities to transfer knowledge gained on management actions and science to assist the GCDAMP.
- Although improvements are needed in GCDAMP processes to insure more effective transitions of management and science activities, the review found this to be normal occurrence in many AM programs. It is described in AM literature as “Double Loop Learning” and is critical to effective AM programs.

RECOMMENDATIONS

The following recommendations are proposed related to management/science transitions in the GCDAMP.

- The GCDAMP HBC goal appears to approach a recovery implementation program. If the GCDAMP is incorporating RIP direction informally, it should be clarified in mission, goals and objectives.
- Goals should be made more specific and prioritized more effectively to assist program and budget planning on management actions and science.
- Desired future resource conditions should be developed for all resources to effect appropriate planning of management actions and science.
- Near term program and budget planning must have improved direction from stakeholders and managers as to priority needs. Definitions of minimal levels of resolution, types and amounts of information needed as well as accuracy requirements can be improved.
- Out year program and budget planning (5-10 years) needs to be improved to help identify additional management actions and science needs as well as forced reductions in programs from budget shortfalls.
- Monitoring programs under development must be explicitly designed to detect change in key indicators of resources of concern. A focus on design parameters that identify minimal information needs to define resource changes is important.
- Abilities to identify, in advance, potential perturbations to the system assists management and science transitions. Improvements in program planning and budgeting, simulation models, tradeoff models and decision support systems would benefit these identifications.

Evaluating Criteria Guiding Transition of Science and Management Activities in Adaptive Management Programs



SCIENCE ADVISORS

Lance Gunderson & David Garrett

Adaptive Management Work Group Meeting

Phoenix, AZ

August 24-25, 2010

Project Objectives

Literature Review:

- Evaluate literature for criteria defining science based management actions and effective science/management action transition

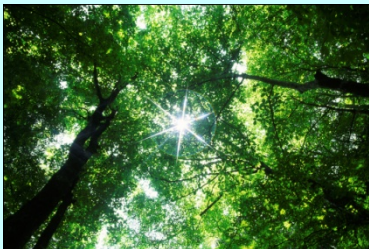
Review Existing AM Programs:

- Survey active AM programs for criteria being utilized for managing transitions

Findings From Literature and AM Programs

AEAM Development; 1970-1980s

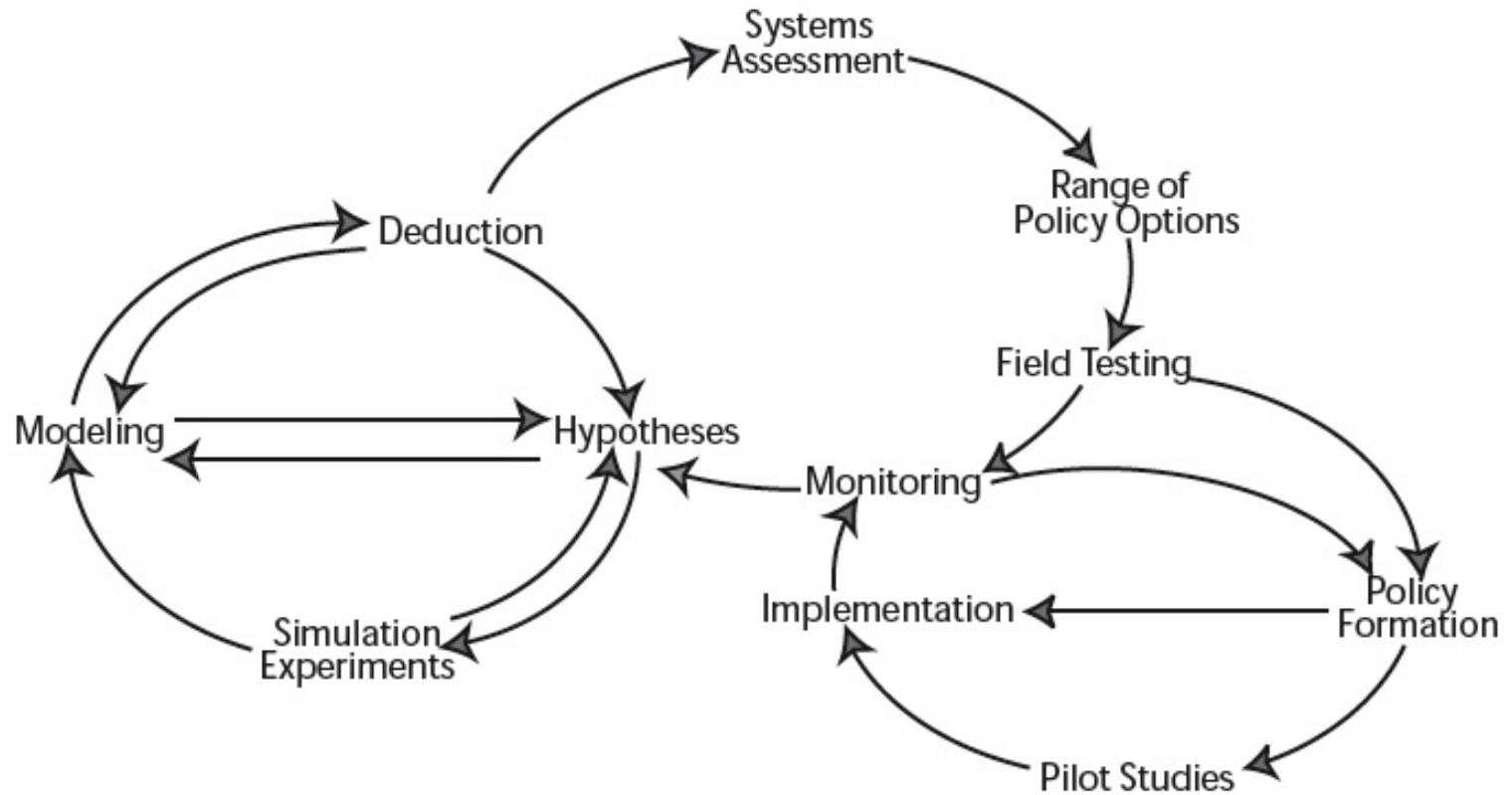
- Ø Need to incorporate input from diverse scientific/technical groups (Integrative understanding)
- Ø Need to address large complex natural resource management issues under significant uncertainty
- Ø Need to conduct policy experiments using management actions and monitoring (Fill knowledge to action gap)

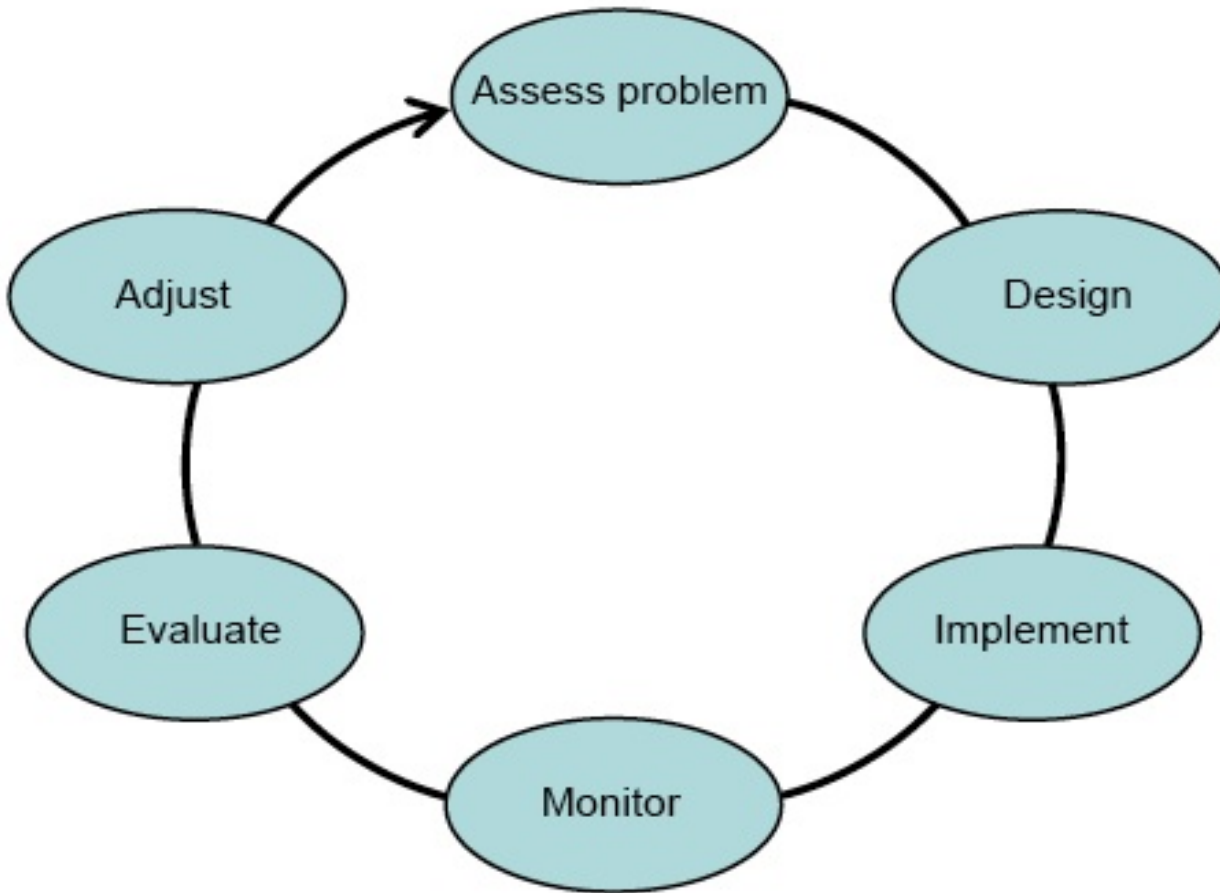


AEAM Development

- Ø Relatively new approach in management science
- Ø Development of methodology in 1970s to 1990s
- Ø Incorporates both passive and active approaches
- Ø Utilizes concepts from several science areas
 - Ø Management science
 - Ø Probability theory
 - Ø Risk and uncertainty
 - Ø Decision theory
 - Ø Ecosystem science

The Holling Model





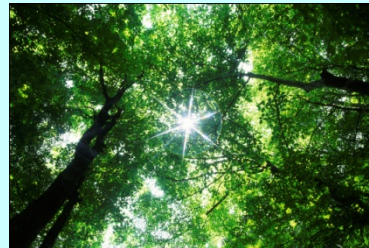
Dept. of Interior –Adaptive Management Model

AM Theory and Practice Does Not Identify Need to Resolve Certainty Before Implementing Management Actions

- § AM accepts reality that we cannot resolve uncertainty in complex natural resource programs
- § Adapted to issues of continued high uncertainty where traditional science paradigms have limited effectiveness
- § AM approach is “learning by doing management”, i.e. establish policy experiment; implement management actions; monitor results; evaluate; revise management actions
- § Use of risk analysis, probability theory, tradeoff analysis, etc. to respond to managers willingness to accept risks
- § Cyclic learning creates science basis for management action

Two Key Findings Of Review

- AM process treats management/science as a continuum of activities; blurs rather than clarifies boundaries
- Learning is key process that links management and science transitions; integration of knowledge and understanding through AM process



Adaptive Management Conservation Programs Reviewed

- Kissimmee River Restoration Program
- Cal-Fed ERP
- Lower Bridge River Restoration Program
- Trinity River Restoration Program
- Platte River RIP
- Lincoln National Forest Restoration Program
- San Juan River RIP
- Upper Colorado River RIP
- Lower Colorado Multispecies Conservation Plan
- Apache Sitgreaves NF Restoration Program

Approach to Evaluate Criteria Used for Management/Science Transitions

- Identify AM attributes from literature that effect management/science transitions.
- Identify attribute areas needing improvement in GCDAMP.
- Identify criteria from operating AM programs offering potential improvements to GCDAMP.

AM Programmatic Categories that Influence Transitions

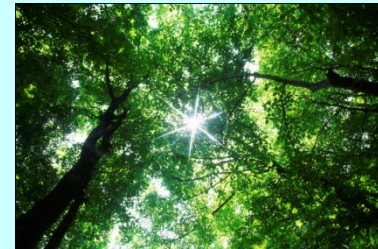
- Organization, Goals and Entity Roles
- Program Planning and Budgeting
- Science and Monitoring

Organization, Goals, Entity Roles

- GCDAMP
 - GCDAMP uses informal consensus building in its processes.
 - Reviews reveal improved criteria for consistent consensus building, dispute resolution, tradeoff and risk assessment, decision processes could assist program.

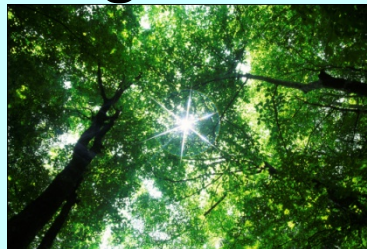
Organization, Goals, Entity Roles

- Kissimmee River Restoration Program Collaborative Processes
 - Multiple groups, multiple formal and informal approaches. Extensive committee problem solving.
 - Multiple revisions of approaches. Developed new methods and criteria.



Organization, Goals, Entity Roles

- Lincoln National Forest Restoration Program Collaborative Processes
 - Multiple groups and monthly committee meetings for problem solving.
 - Consistent use of informal, formal and structured analytical methods to communicate tradeoffs and derive understanding and consensus.

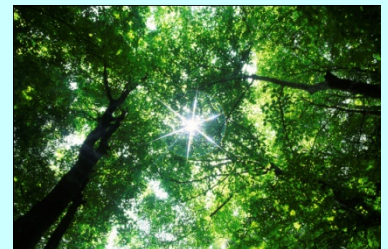


Organization, Goals, Entity Roles

- Lower Bridge River CAM.
 - Working group and committees.
 - Continued use of structured informal, formal and analytical criteria for consensus building, dispute resolution, tradeoff assessments, decision making.

Organization, Goals, Entity Roles

- GCDAMP has goals, priorities, selected DFCs.
 - Reviews identified need for improved goal, dfc, priority, role specification..



Organization, Goals, Entity Roles

- Upper Colorado, San Juan and Platte River RIPs
 - Programs use law, regulation, authorities and responsibilities of involved federal and state parties to develop explicit criteria for AM processes.
 - Entity roles explicit, including funding. Science focus is on monitoring. Less clarity in LTEP process

Organization, Goals, Entity Roles

- CAL-FED ERP has very structured processes and criteria for setting goals, priorities, establishing entity roles, integrating and transitioning management actions/science, and review and revision of all AM elements
- A/SNFRP blends processes of AM and NEPA formats, including ID teams, working groups, committees, etc.
- Trinity River RP has both developed criteria and processes for specification of goals, priorities and their reevaluation.

Program Planning

- Improved criteria needed for specification of manager/stakeholder information needs; i.e. type, amount, resolution, accuracy; etc. Difficulties in providing specification because of uncertainties, and lack of tradeoff and decision processes, etc.

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Program Planning

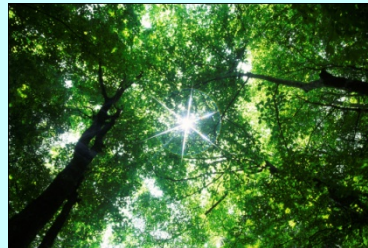
- Improved specification of information needs.
 - LNF RP uses several models to evaluate tradeoffs and support decision and NEPA processes to inform AM and evaluate minimal information needs.
 - Lower Bridge River RP uses structured analytic tradeoff and decision support systems in workshops to manage information needs planning and costs.

Program Budgeting

- GCDAMP uses short term budget planning (1-3 years), but 10 year planning needed
- GCDAMP reviews reveal lack of criteria for long term programs and budget plans to guide management action/science transitions.

Program Budgeting

- Long Term Program and Budget Planning
 - CAL-FED, South Florida CERP, Kissimmee River, Migratory Bird Programs have sophisticated out year budget planning criteria for increasing, decreasing, level budgets.
 - Upper and Lower Colorado RIPS have long term program and budget plans, i.e. 10-50 years to address critical program junctures.



Monitoring Programs

- GCDAMP/GCMRC has monitoring programs in place, but no formal approval of its CMP
- Reviews reveal manager/stakeholder specifications of explicit long term monitoring requirements are needed.

Monitoring Programs

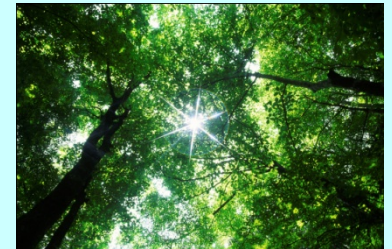
- Migratory waterfowl harvest programs have developed criteria for monitoring both biophysical and socio-economic impacts to permit annual changes
- CAL-FED programs have well developed guideline documents for biophysical/socioeconomic monitoring program development, costs, revisions

Conclusions

- AM is an integrative approach to solving complex resource management issues.
- AM addresses dynamic natural resource issues with policy experiments where uncertainty cannot be resolved and increased risks exist in decision processes.
- Traditional science models of controlled experiments to resolve uncertainty and risk prior to management actions have limited application.
- AM depends on integration of management/science in cyclic pattern of defining and implementing management actions, monitoring and evaluating resource impacts, and implementing revised management actions.

Conclusions, cont.

- Criteria and guidelines for effective programmatic transitions of AM processes are critical to insuring management/science transitions. Several require improvement in the GCDAMP.
 - Organization, goals and entity roles
 - Program planning and budgeting
 - Effective monitoring approaches
- Opportunities exist to learn and adapt criteria from other AM programs to improve GCDAMP management/science transitions.
- All AM programs have problems, GCDAMP has overcome many of these issues.



Recommendations

- To improve management/science transitions GCDAMP should review and improve several areas of its programs.
- Improved criteria should be developed and continually used for consensus building; conflict resolve; goals and dfc's; entity roles; tradeoff and decision methods; planning and budgeting; monitoring programs.
- Following the Secretary and AMWG direction on dfcs, roles and other EIS related proposals, the TWG/GCMRC/SA should accomplish as possible improved criteria and guidelines over the next three years.
- The SAs propose assistance on tradeoff and decision methods in FY 2011/2012.