

Adaptive Resource Management

Adaptive management is a decision process that promotes flexible decision making that can be adjusted as outcomes from management actions and other events become better understood (Williams et. al 2007). Monitoring of these outcomes advances scientific understanding and supports adjustments in policies and operations.

Adaptive management provides for addressing biological/ecological, social, and economic goals with stakeholder involvement.

Passive adaptive management focuses on implementation of management actions followed by review and evaluation of outcomes (Allan 2007). Important components of effective passive management include:

- Evaluation
- Reflection
- Communication
- Incorporation of learning into planning and management

Active adaptive management entails a stronger emphasis on learning by utilizing methods to test hypotheses (e.g., using a range of treatments and monitoring results) and is not being proposed for this process.

Adaptive management approaches are used in several Minnesota DNR Fisheries Management Section large lake plans.

- *Harvest Plans for Red Lakes Walleye Stock*
- *Fisheries Management Plan for the Minnesota Waters of Lake Superior*
- *Lake Management Plan, Lake Vermilion*

Using a more formal adaptive management framework has the potential to increase collaboration and learning among diverse interests, and increase transparent decision making.



Figure 1.1. Diagram of the adaptive management process.

Adaptive Resource Management – Set Up Phase

Step 1 – Stakeholder Involvement: Ensure stakeholder commitment to adaptively manage the enterprise for its duration.

- a. Stakeholders must strive for agreement on scope, objectives, and management alternatives.
- b. Stakeholders must commit to a process for adjusting management strategy over time, based on resource status and learning.

Step 2 - Objectives: Identify clear, measurable, and agreed upon management objectives to guide decision making and evaluate management effectiveness over time. An objective is a desired outcome or performance measure; a purpose is a broader statement indicating why management is being undertaken.

- a. Objectives substantively influence decisions and management strategies.
- b. Objectives should incorporate social, economic, and/or ecological values of stakeholders and reflect the value of learning over time.
- c. To be useful as guides for decision making and evaluation, objectives should be specific and unambiguous, measurable with appropriate field data, achievable, results-oriented, and applicable over the timeframe.
- d. Objectives can be qualitative or quantitative; quantitative objectives can be easily measured .
- e. Multiple objectives should be ranked or prioritized. Objectives may be used to rank management actions.

Step 3 – Management Actions: Identify a set of management actions for decision making.

- a. Potential actions consist of activities under management control (e.g., harvest, stocking, restoration).
- b. Alternatives typically focus on alterations of resource status or process rates.
- c. The suite of available actions should be designed to promote learning.
- d. The alternatives should be explicit and documented.
- e. Note: Because of natural variation, resource systems are often extraordinarily difficult to control with management actions and “cause and effect” relations are usually unclear and difficult to recognize.

Step 4 – Models: Identify models that characterize ideas about how the dynamic natural resource system works. A model is a plausible representation of a dynamic resource system; informal description of a system positively and negatively influenced by factors or formal mathematical expression of a system change. Models allow forecasts to be made regarding the impacts of management and express benefits and costs as outputs of management through time.

- a. Models in adaptive management should characterize system behaviors and responses to management actions.

- b. Models should incorporate different ideas about how the resource system works and how it responds to management.
- c. The suite of models should capture key uncertainties or disagreements about resource processes and management effects.
- d. Models must be compatible with, and calibrated to, available data and knowledge.
- e. It is important to compare and contrast management alternatives in terms of their costs, benefits and resource consequences.
- f. Model attributes:
 - i. Resource systems are described as changing over time. As learning occurs, management adapts to learning.
 - ii. The resource system is characterized by key components of interest (e.g., population size, resource biomass, biodiversity) that are the focus of management and the targets of monitoring.
 - iii. Resource changes are described in terms of processes (e.g., reproduction, mortality, movement) that are thought to be directly influenced by management.
 - iv. Fluctuating environmental conditions are incorporated as needed to characterize resource dynamics.
 - v. Management impacts are described in terms of cost, benefits, and influences on resource components or processes highlighted in the model.
 - vi. Models are calibrated with available data and knowledge, to ensure compatibility with current understanding about resource structures and functions.

Step 5 – Monitoring Plans: Design and implement a monitoring plan to track resource status and other key resource attributes. Monitoring plans provide data for four purposes: (i) to evaluate progress toward achieving objectives, (ii) to determine resource status in order to identify appropriate management management actions, (iii) to increase understanding of resource dynamics through the comparison of predictions against survey data, and (iv) to enhance and develop models of resource dynamics as needed and appropriate.

- a. A monitoring plan should be designed to estimate system state and other attributes needed for decision making and evaluation.
- b. The plan should promote learning through a comparison of estimates against model-based predictions.
- c. The plan should be efficient, in that it produces estimates that have maximum precision for a given cost, or minimum cost for a given level of precision.

ADAPTIVE RESOURCE MANAGEMENT - ITERATIVE PHASE

Step 6 – Decision making: Select management actions based on management objectives, resource conditions, and understanding.

- a. At each step in time, selection of a management action is made from the set of possible alternatives.
- b. The selection of a management action is guided by objectives, which are used to evaluate alternatives and identify an action that contributes to meeting the objectives.
- c. The appropriate action depends on resource status and the current level of understanding about resource dynamics.
- d. Management is adjusted over time as resource conditions change and understanding evolves.

Step 7 – Follow-up monitoring: Use monitoring to track system responses to management actions.

- a. Monitoring typically occurs after management interventions.
- b. Resource status and other key indicators of impacts are estimated with monitoring data.
- c. Estimates based on monitoring data are used to evaluate management impacts and inform decision making at the next decision point.
- d. Because the amount of monitoring data increases over the course of an application, the amount of information about system processes also increases.

Step 8 – Assessment: Improve understanding of resource dynamics by comparing predicted and observed changes in resource status.

- a. Assessment/analysis includes parameter estimates, comparative assessments, and prioritization of management alternatives.
- b. Comparison of predicted and actual responses is used to update understanding of management impacts.
- c. Comparison and ranking of projected outcomes for management alternatives is used in selection of management actions.
- d. Comparison of desired and actual outcomes is used to evaluate management effectiveness.

Step 9 – Cycle back to Step 6 and repeat management action → monitoring → assessment.

- a. The cycle of Steps 6 through 9 is repeated until the end of the timeframe.
- b. Iterations can begin at any point in the cycle; however, a natural entry point is with decision making.
- c. The direct linkage from assessment to management action expresses the contribution of learning to decision making, by providing information on which to base “smart” decisions.
- d. The linkage from management action to assessment expresses the contribution of management to learning, through interventions that are useful in investigating the resource system.

Box 4.1 Adaptive Management Operational Steps

Set-up phase

- ❖ *Step 1 - Stakeholder involvement*
Ensure stakeholder commitment to adaptively manage the enterprise for its duration
- ❖ *Step 2 - Objectives*
Identify clear, measurable, and agreed-upon management objectives to guide decision making and evaluate management effectiveness over time
- ❖ *Step 3 - Management actions*
Identify a set of potential management actions for decision making
- ❖ *Step 4 - Models*
Identify models that characterize different ideas (hypotheses) about how the system works
- ❖ *Step 5 - Monitoring plans*
Design and implement a monitoring plan to track resource status and other key resource attributes

Iterative phase

- ❖ *Step 6 - Decision making*
Select management actions based on management objectives, resource conditions, and enhanced understanding
- ❖ *Step 7 - Follow-up monitoring*
Use monitoring to track system responses to management actions
- ❖ *Step 8 - Assessment*
Improve understanding of resource dynamics by comparing predicted vs. observed change in resource status
- ❖ *Step 9 - Iteration*
Cycle back to Step 6 and, less frequently, to Step 1

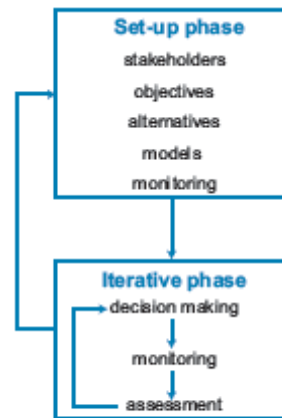


Figure 3.4. Two-phase learning in adaptive management. Technical learning involves an iterative sequence of decision making, monitoring, and assessment. Process and institutional learning involves periodic reconsideration of the adaptive management set-up elements.

References:

Allan, C. 2007. Adaptive management of natural resources. Proceedings from the 5th Australian Stream Management Conference. Charles Sturt University, New South Wales.

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2007. *Adaptive Management: The U.S. Department of Interior Technical Guide*. Adaptive Management Working Group, U.S. Department of Interior, Washington, DC.

PROBLEM/PURPOSE: Managing for a sustainable walleye fishery in Leech Lake (2011 – 2015)

Objectives/Tradeoffs			
Assumptions about Walleye Population (e.g., consider growth and mortality factors)		Key Uncertainties	
Decision Alternatives (Potential Management Actions)	Consequences of Action	Tolerance for Potential Consequences of Decision	Monitoring and Evaluation/Accounting for Future Impacts of Decision
Walleye stocking 1. 2. 3. etc			
Harvest regulations 1. 2. 3. etc			
Cormorant population 1. 2. 3. etc			
Habitat protection 1. 2. 3. etc			
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