Structured Decision-Making in Avian Conservation

Is it really that easy?

James (Barry) Grand

original graphic art by:
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Transparency in decision-making…

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Stuctured Decision-making & Adaptive Management

- Terms have become commonplace
- Over 300 papers 2000-2009 on Web of Science
  (Huang et al. 2011)
- Google scholar
  - Adaptive Management & Wildlife - >55,000 hits
  - Structured Decision-making & Wildlife > 29,000 hits
- Documented successes are rare
- Barriers to implementation abound

What are they – really?

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Presentation outline

- Define Structured Decision-making and Adaptive Management
- Dismiss some common misconceptions
- Discuss the key elements of each
  - Roles of stakeholders, decision-makers, biologists, and researchers
- Identify factors limiting implementation
- Answer the question:

Is it really that easy?

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Background

- Concepts used in natural resources management since the late 1950's (Beverton and Holt 1957)
- Formally introduced in 1978
  - Hollings (1978)
  - Walters and Hilborn (1978)
- More explicit treatment by Walters (1986)
- Socio-political treatment by Lee (1993)

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The recent cast of characters

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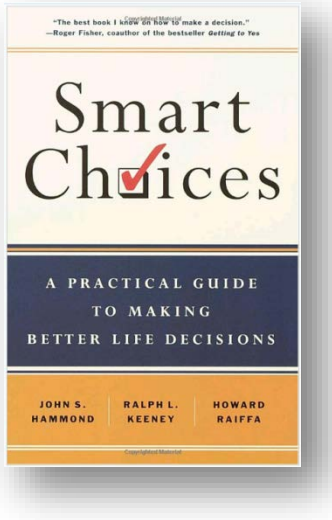
Structured decision-making (SDM)

What is it?

"A formal application of common sense for situations too complex for the informal use of common sense."

R.L. Keeney



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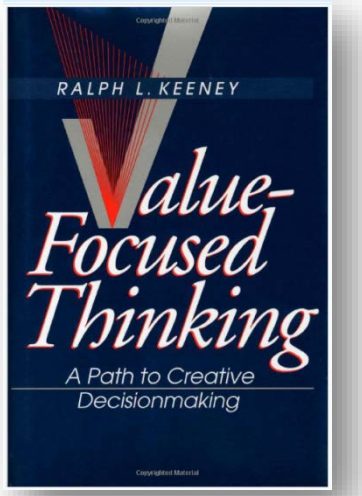
Structured decision-making (SDM)

- Term used to describe the application of decision analysis to natural resources management

- Generalized approach
  - One-off decisions
  - Iterative decisions (Adaptive management)

- Values-Focused Thinking by R.L. Keeney



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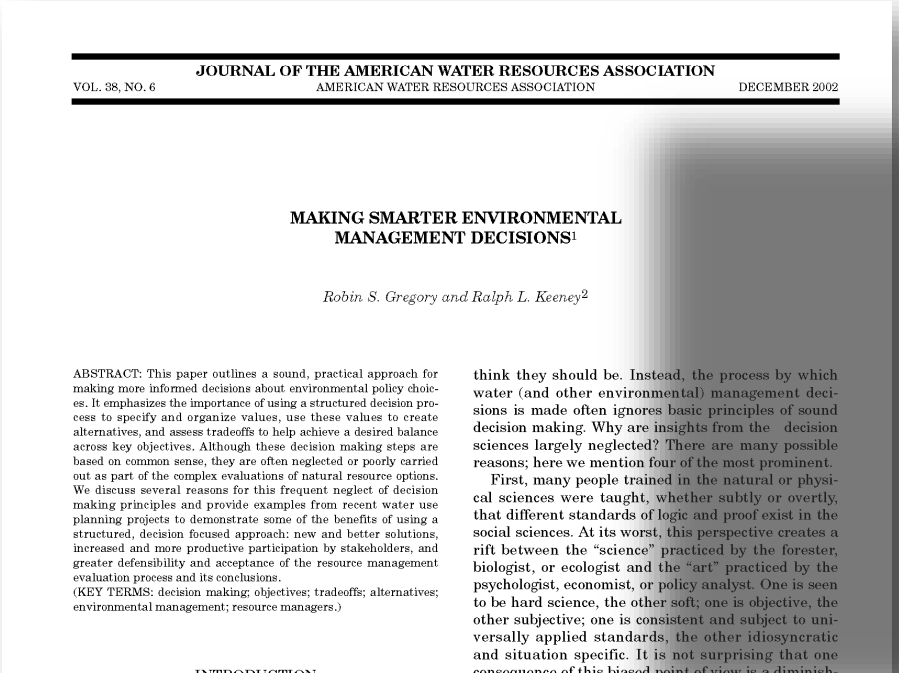
Two good examples

- Gregory, R.S., and R.L. Keeney. 2002. Making smarter environmental decisions. Journal American Water Resources Association. 38(6):1601-1612.
- Lyons, J.E., M.C. Runge, H.P. Laskowski, W.L. Kendall. 2008. Monitoring in the context of structured decision-making and adaptive management. Journal of Wildlife Management. 72(8):1683–1692.



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MAKING SMARTER ENVIRONMENTAL MANAGEMENT DECISIONS[1]

Robin S. Gregory and Ralph L. Keeney[2]

ABSTRACT: This paper outlines a sound, practical approach for making more informed decisions about environmental policy choices. It emphasizes the importance of using a structured decision process to specify and organize values, use these values to create alternatives, and assess tradeoffs to help achieve a desired balance across key objectives. Although these decision making steps are based on common sense, they are often neglected or poorly carried out as part of the complex evaluations of natural resource options. We discuss several reasons for this frequent neglect of decision making principles and provide examples from recent water use planning projects to demonstrate some of the benefits of using a structured, decision focused approach: new and better solutions, increased and more productive participation by stakeholders, and greater defensibility and acceptance of the resource management evaluation process and its conclusions.
(KEY TERMS: decision making; objectives; tradeoffs; alternatives; environmental management; resource managers.)

think they should be. Instead, the process by which water (and other environmental) management decisions is made often ignores basic principles of sound decision making. Why are insights from the decision sciences largely neglected? There are many possible reasons; here we mention four of the most prominent.

First, many people trained in the natural or physical sciences were taught, whether subtly or overtly, that different standards of logic and proof exist in the social sciences. At its worst, this perspective creates a rift between the "science" practiced by the forester, biologist, or ecologist and the "art" practiced by the psychologist, economist, or policy analyst. One is seen to be hard science, the other soft; one is objective, the other subjective; one is consistent and subject to universally applied standards, the other idiosyncratic and situation specific. It is not surprising that one

SDM core elements - PrOACT

- **Pr**oblem – Solve the right problem
- **O**bjectives – Describe the desired outcomes
- **A**lternatives – Means for achieving objectives
- **C**onsequences – Predicting outcomes of alternatives
- **T**radeoffs – Incorporate values, uncertainty, and seek optimal solutions
  - Core of structured decision-making (Hammond et al. 1999).

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Three additional elements - URL

- **U**ncertainty – System response, environment
- **R**isk Tolerance – Gravity of the problem
- **L**inked Decisions – Complex, dynamic systems

  - More specialized concepts
  - Usually important in ecological decisions

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Adaptive management (AM)

- ...a [decision] process with deliberative and iterative phases, with their sequential implementation over the timeframe of an application.

Williams (2011) J. Environ. Manage.

- ...flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.

National Research Council (2004)

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Definitions

- Simply put:

“Managing to learn and learning by managing”

B.K. Williams

- Consequences
  - Improved understanding of the resource and
  - Improved management based on that understanding.

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Learning and Adaptive Management

- Feedback between learning and decision-making is a defining feature
- Management conducted by design with the goal of learning to manage effectively
- Necessitates management (experimentation) useful for learning
  - Scope – large enough to span the problem
  - Scale – large enough to have an effect
  - Replication – enough to provide statistical rigor

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Management & experimentation

- Typically science emphasizes Type I errors
  - Rejecting the null
  - Probability of incorrectly accepting information
  - High standard for failing to reject ($Pr < 0.05$)

- Emphasis on Type II errors
  - Probability of falsely rejecting useful information
  - Management decisions often based on much lower standard ($Pr > 0.5$)

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How SDM & AM work

- Break problems in into key components
  - Makes decision-making transparent
- Identify the difficulties in making decisions
- Identify key uncertainties
  - System (management) response
  - Environmental variation
- Provide a wide array of tools for decisions-making
  - Spreadsheets
  - Decision networks
  - Decision trees
  - Dynamic programming

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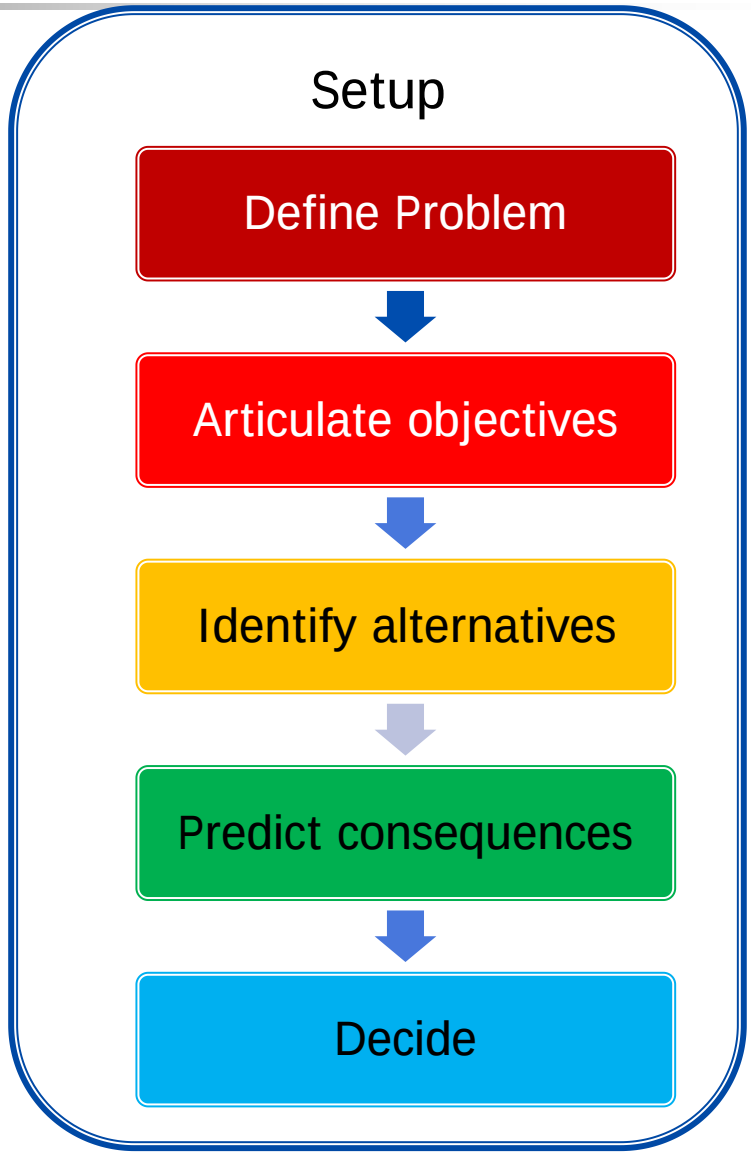
SDM and Adaptive Management (AM)

- **Pr**oblem
- **O**bjectives
- **A**lternatives
- **C**onsequences
- **T**radeoffs



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General features of AM SDM

- Managed system is dynamic in response to environment and management
- Environmental variation is only partially predictable (i.e., stochastic)
- Periodic management can vary over time and has direct or indirect effects on the system state (e.g., size or distribution) or ecological processes (e.g., mortality or movement)
- Uncertainty about system processes and the influence of management

Misconceptions

- Not trial and error – *ad hoc* process
  - "Try something, and if it doesn't work try something else.“

- SDM & AM Require:
  - Articulation of objectives
  - Identification of management alternatives
  - Prediction of consequences,
  - Recognition of key uncertainties, and
  - Monitoring
  - Re-assessment

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Misconceptions

- Large amounts of data are required for setup
- Complex models required

- SDM & AM
  - Often start with conceptual models
  - Appropriate data is often unavailable
  - Management is conducted experimentally to inform decision-making
  - Rely upon simplifying assumptions

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Roles in SDM & AM

Key Element	Stake-holders	Decision Makers (Principals)	Managers (Agents)	Researchers (Analysts)
Problem	✓	✓	✓	
Objectives	✓	✓	✓	
Alternatives	✓	✓	✓	✓
Consequences			✓	✓
Tradeoffs	✓	✓		
Uncertainty			✓	✓
Risk tolerance	✓	✓	✓	
Linked Decisions	✓	✓	✓	✓

SDM core elements - PrOACT

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Get the problem right

- *Extra time to craft a concise yet comprehensive and accurate problem definition pays off…* (R. Keeney)

- Critical first step in structured decision making
  - Make sure you're solving the right problem!
  - Guides process toward appropriate tools and information
  - Determines appropriate level of investment

- Requires input from many groups
  - Stakeholders
  - Decision-makers
  - Managers

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Describe the PROBLEM

Who?	• Who are the decision makers? • Who is affected by the decision?
What?	• What resources are affected? • What is the goal of the project?
Where?	• Where are the affected resources?
When?	• When is the decision needed? • How often will decisions be made?
Why, why, why?	• Why is this important? • Leads to objectives!
How?	• How will the problem be solved? • How will we know if we are successful?

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Objectives

Used to gauge success

- Must be measurable

What we are really managing for

- Must ultimately be affected by actions

ALL subsequent steps build on these

- Selection of **ALTERNATIVES**
- Evaluation of **CONSEQUENCES**
- **TRADEOFFS** and optimization

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Creating alternatives

- Ask how you can best achieve the objectives
- Challenge constraints
- Avoid “psychological traps”
  - Anchoring on initial values
  - Salient examples
  - Sunk costs
- Do we need to learn first?
  - Adaptive management
  - Requires monitoring & evaluation

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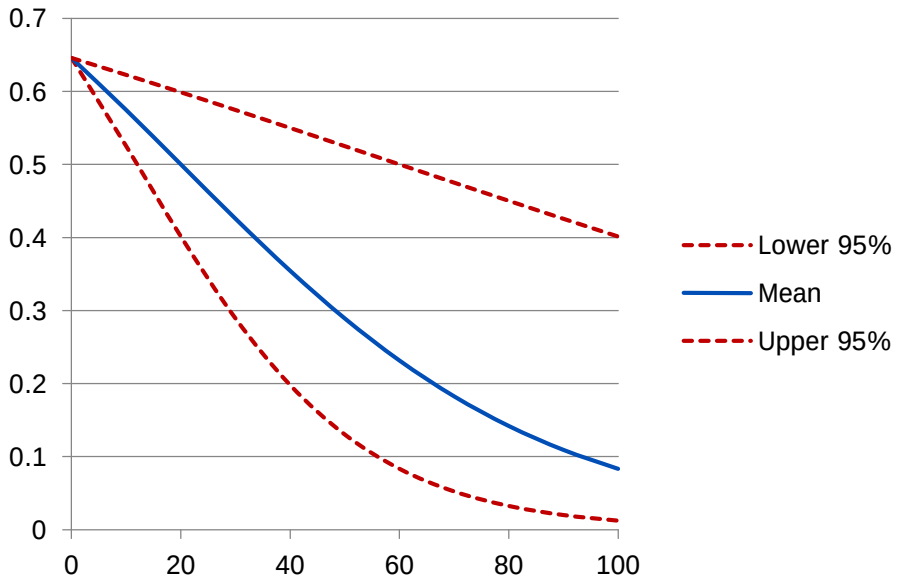
Consequences

- Predict outcomes (objectives)
- Requires a model
  - May be qualitative (initially)
  - Usually quantitative
  - Estimate uncertainty
- Strive for simplicity



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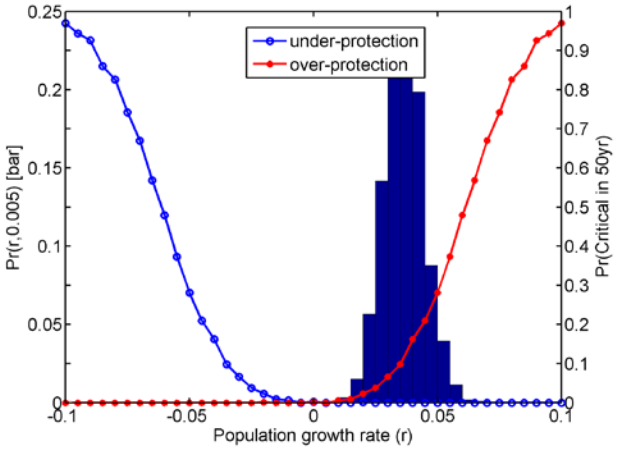
Tradeoffs

- Relative weighting of objectives
- Relative value of the response to **STAKEHOLDERS** and **DECISION MAKERS**

Value = reward * uncertainty * weight

  - Reward – response
  - Uncertainty – confidence
  - Weight - value of the response



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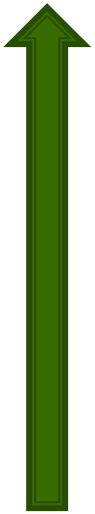
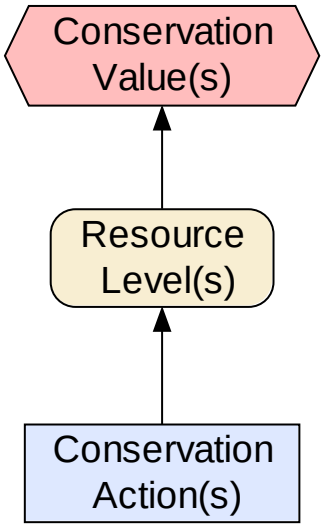
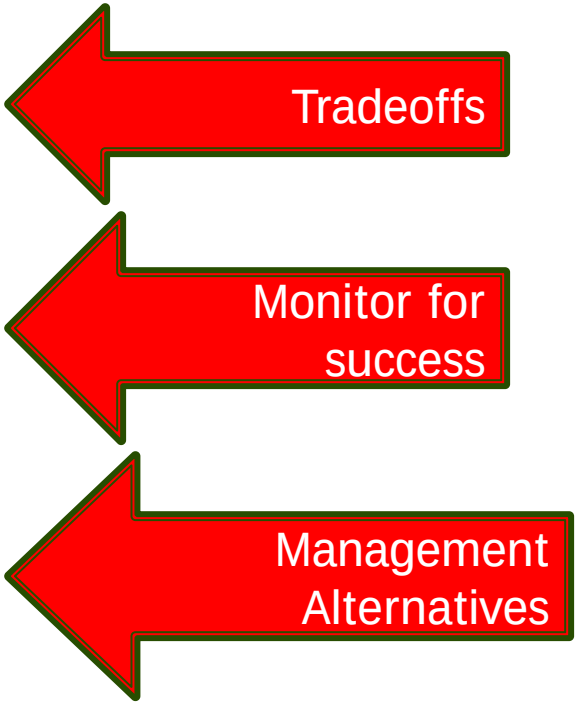
Decision model

Objective
"What's important"



Means
"How we get there"





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Decision model

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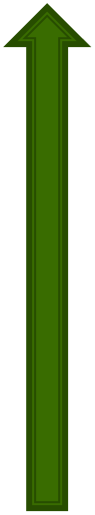

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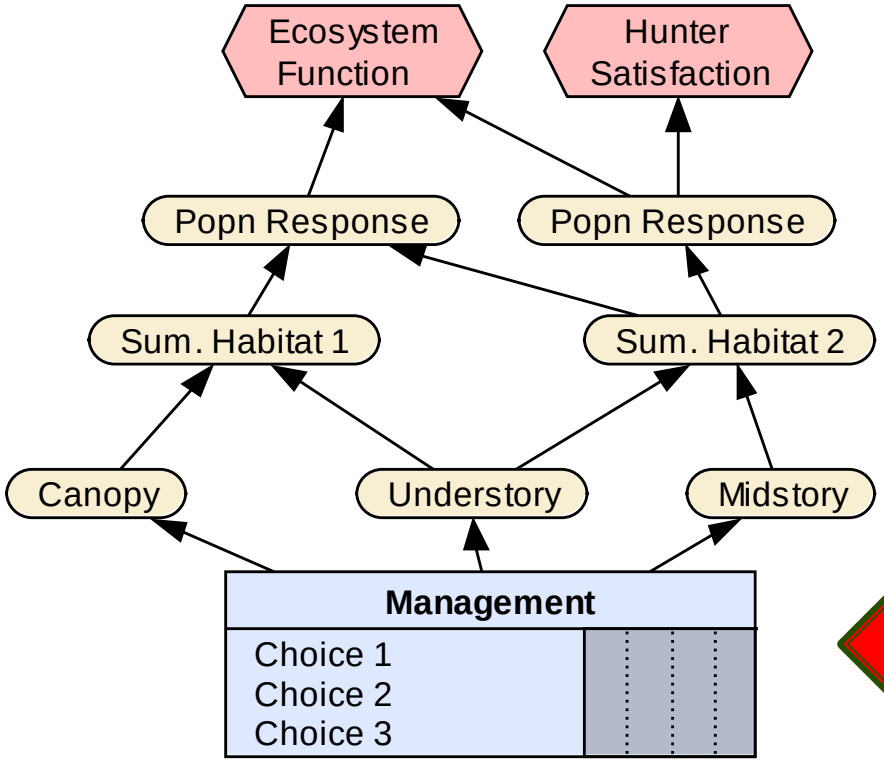

Tradeoffs

Monitoring for success

Management Alternatives

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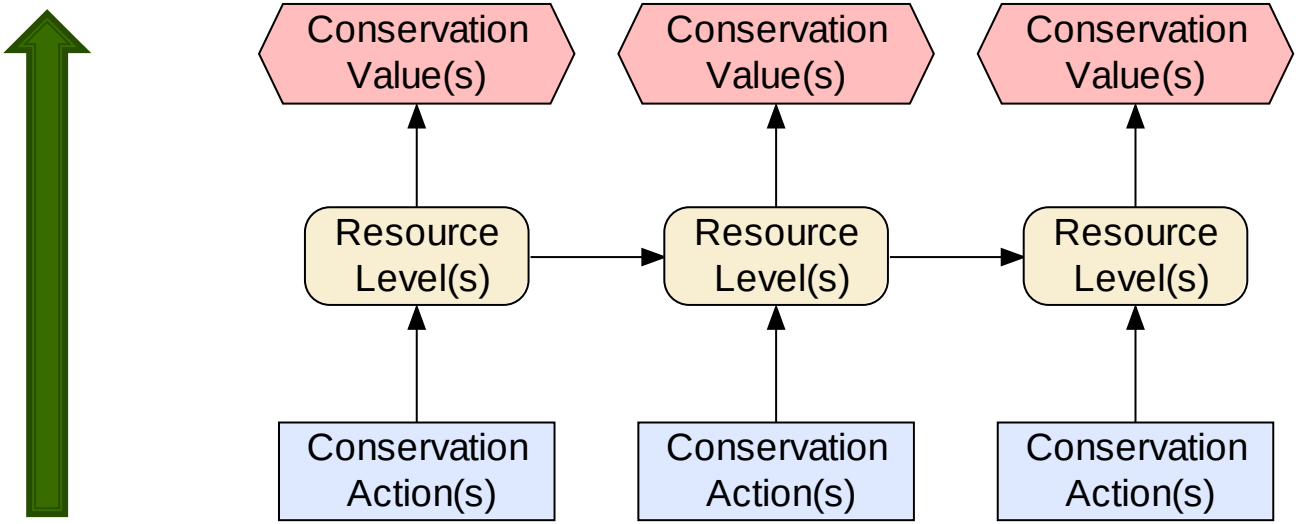
Adaptive management

Objective
"What's important"



Means
"How we get there"

Time

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Forms of AM

- Sequential decisions implemented uniformly over the system
  - A single population
- Multiple populations
  - Treatment of multiple populations as pseudoreplicates
  - Treatments differ between units according to an experiment design
- Active or passive?
  - Active – decisions motivated by reducing uncertainty
  - Passive – decision motivated by meeting objectives

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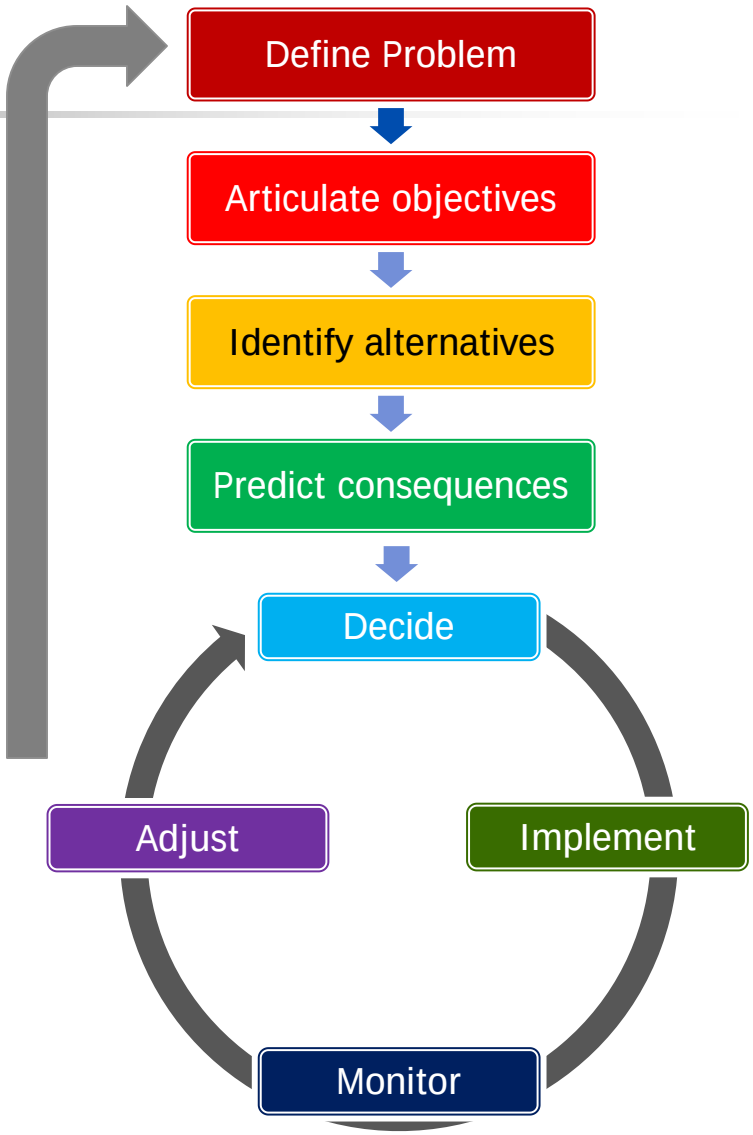
Double loop

- Reconsider the setup
- Is the problem right?
- Are the objectives appropriate?
- Are additional objectives necessary?
- Are additional alternatives available?
- Were the decision criteria appropriate?



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Impediments and failures

- Natural-resources researchers and managers lack training.
- Institutions are not amenable to adaptive management
- Distrust of and resistance to management agencies
- Misapplication to situations where AM is infeasible

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Conclusions

- Some interpret SDM & AM to be one in the same
  - AM may be a special case of SDM
- Both
  - Useful for decisions at multiple scales
    - Local scales
    - Landscape scales
    - Continental scales
  - Embrace and seek to reduce uncertainty
  - Encourage and even require involvement by stakeholders, decision-makers, managers, and researchers
  - Require an approach to research and management that requires additional training

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Is it that easy?

- Technically:
  - Useful for decomposing problems of “wicked” complexity (Gunderson 2011)
  - Not appropriate for every problem (Gregory et al 2006)
- Politically and socially
  - Challenges are **HUGE!!**

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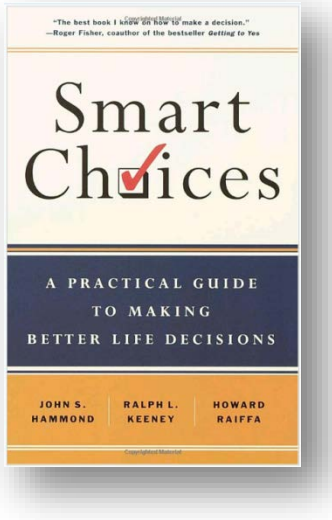

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