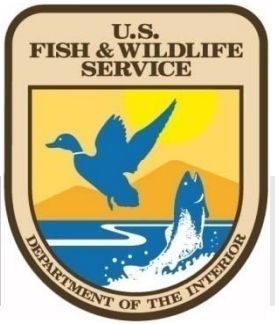

When is Adaptive Management Appropriate?

CSP3176: Adaptive Management:
Structured Decision Making for Recurrent Decisions
Chapter 3

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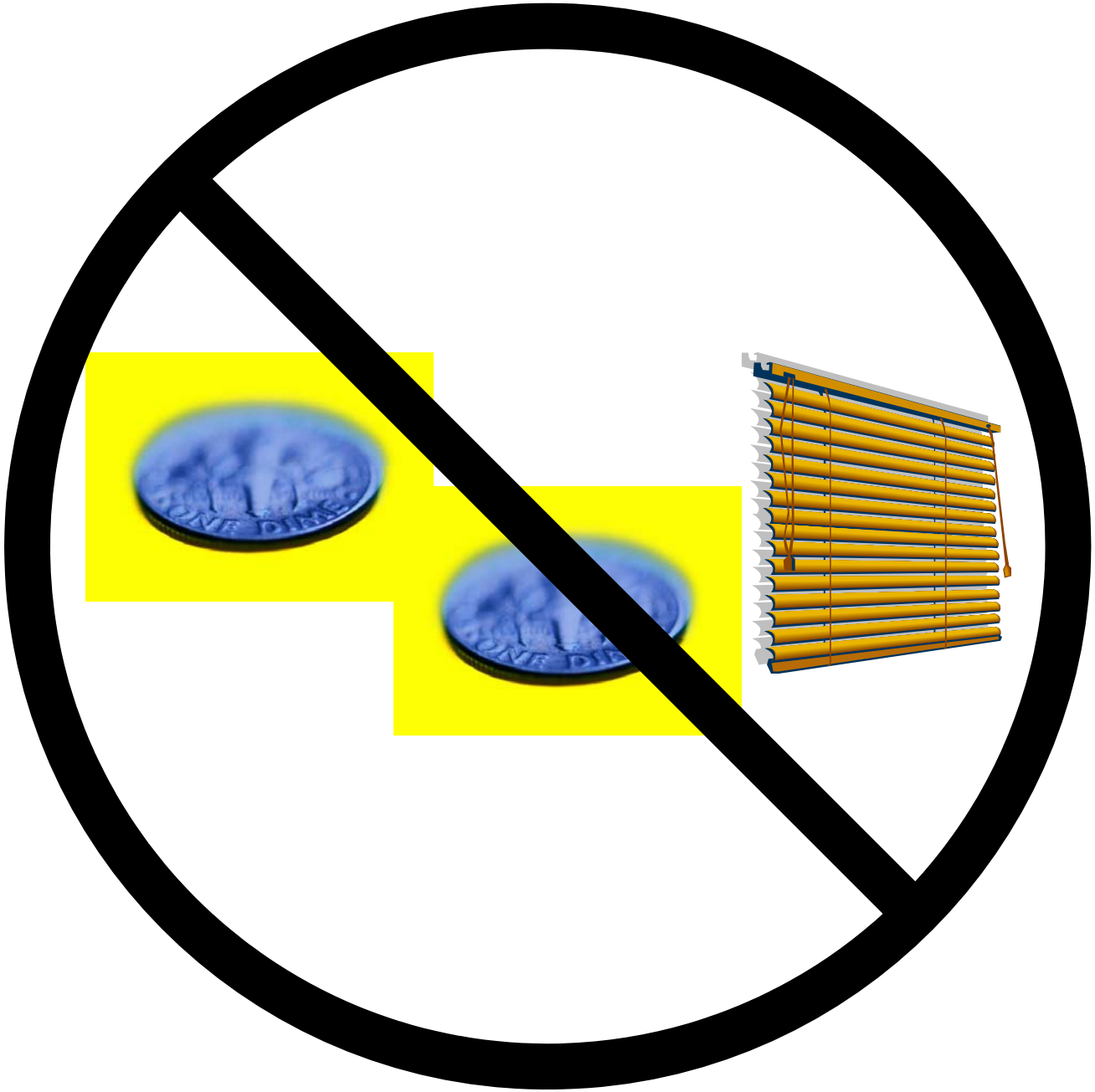


Not Everything Needs AM

- Not all problems can or should be adaptive
  - Sometimes there's no opportunity to learn
  - Sometimes uncertainty doesn't impede the decision
  - Sometimes objectives cannot be identified
- But as you've seen, the concept is so intuitively appealing, that it's been applied indiscriminately
- When is AM rightly called for?

Presumed Conditions

- Two conditions are so fundamental that they are often not even mentioned
  - A mandate to take action in the face of uncertainty
  - Institutional capacity and commitment to undertake and sustain an adaptive program
- Without these, there is neither motivation nor capacity to pursue AM

Six Key Conditions

1. A real management choice is to be made
2. There is an opportunity to apply learning
3. Clear and measurable management objectives can be identified
4. The value of information for decision making is high
5. Uncertainty can be expressed as a set of testable models
6. A monitoring system can be established to reduce uncertainty

from Williams et al. 2007. Adaptive Management: DOI Technical Guide.

1. A real management choice

- AM is an approach to management of natural resources, not simply an opportunity to learn
- Thus, it must involve a real choice among management alternatives that affect resources of concern

Some recent examples

- Reproductive failure of whooping cranes at Necedah NWR
- Emergence of white-nose syndrome in bats in the northeast
- Development of a biological integrity index for salt-water marshes

2. Opportunity to apply learning

- Learning can be applied when decisions are iterated, over time or space
- Learning at early stages improves management at later stages
- Note that this is simply not a ubiquitous condition
  - Many management decisions are made just once

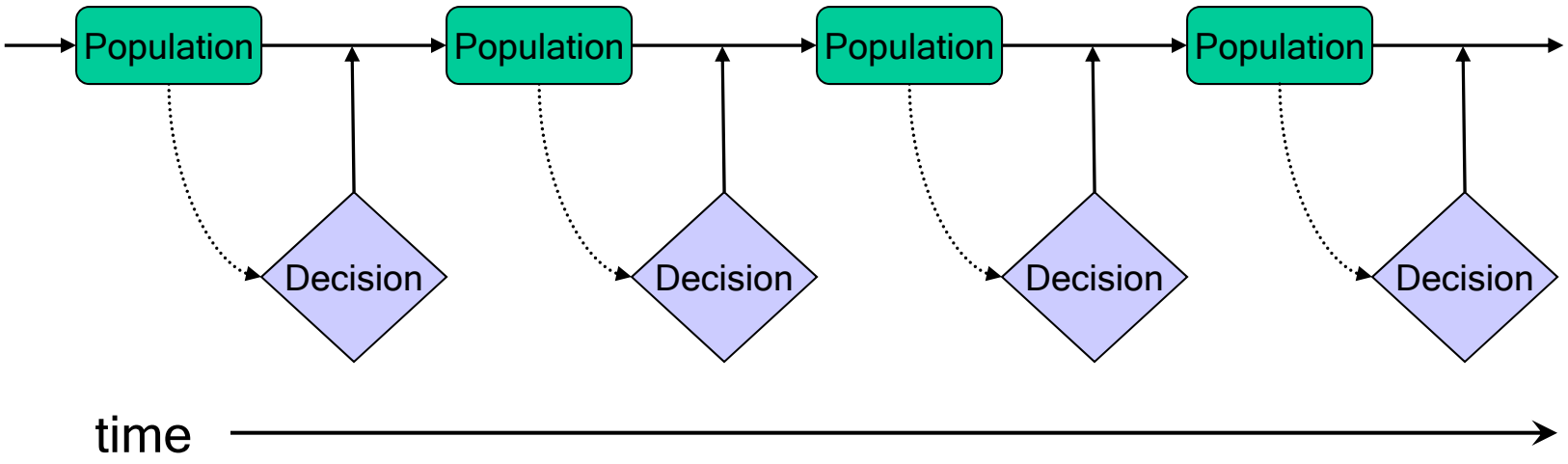
Repeated Decisions

- Situation 1:

  Control of a dynamic resource

  Single population: harvests of deer, releases of condors

  Habitat: grassland management



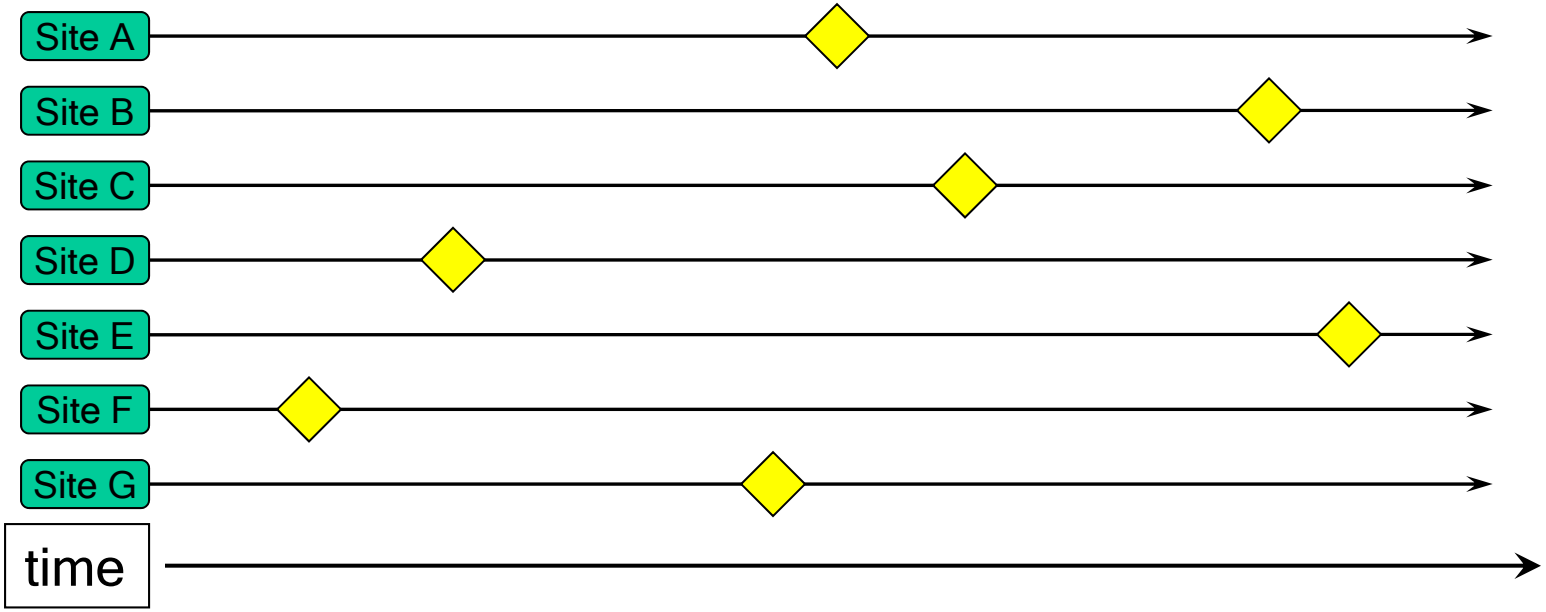
Graphic by Clint Moore, USGS

Repeated Decisions

- Situation 2:

  Series of replicated, one-time decisions

  Examples: Dam removals, small wetland restorations



Graphic by Clint Moore, USGS

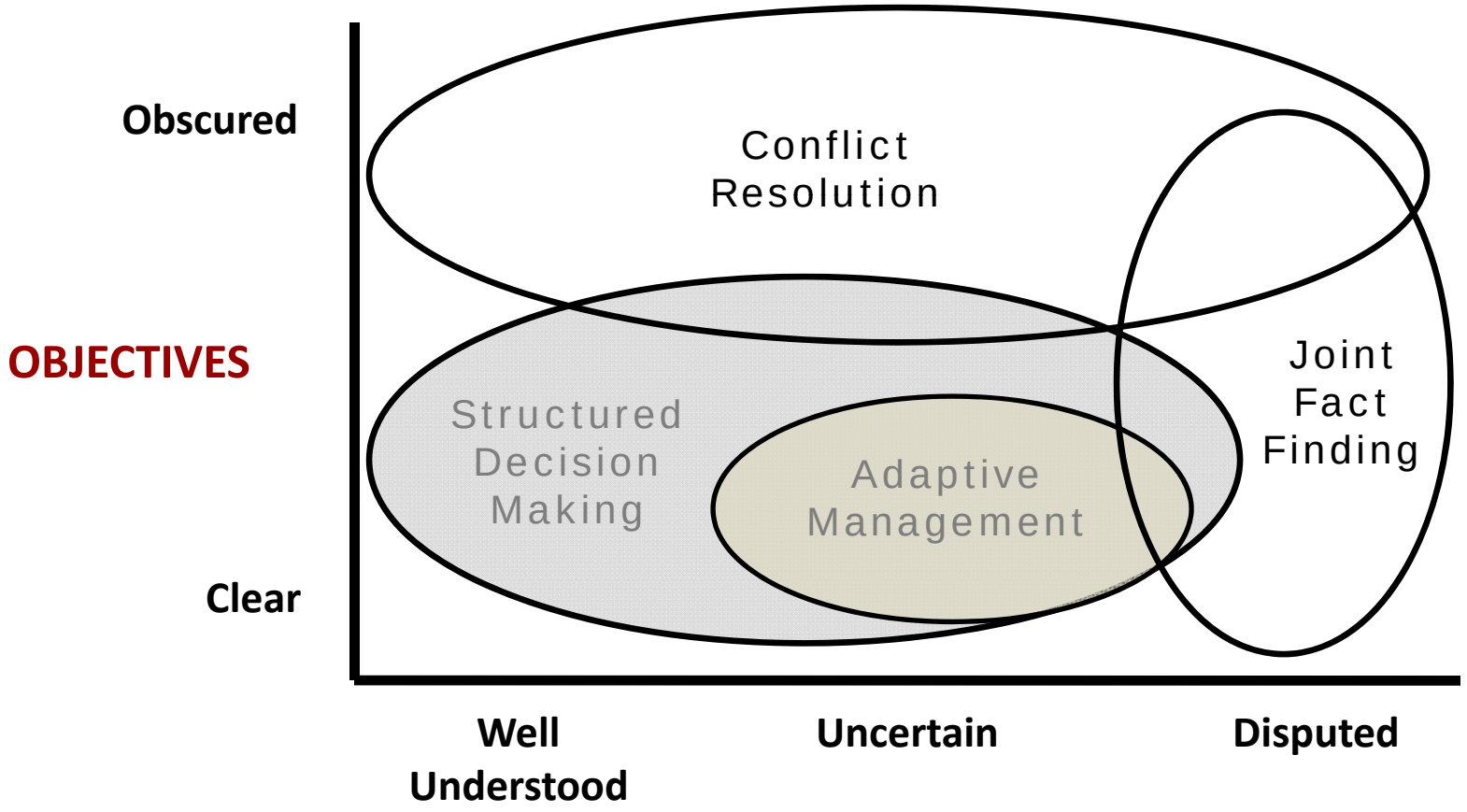
Applying learning also requires…

- Adaptation is possible
  - Different actions can be taken in the future as a result of learning
- Management institutions are stable enough to measure outcomes and apply them later
- Learning occurs fast enough to apply to subsequent decisions

3. Management objectives

- AM requires explicit and measurable objectives
  - Indeed, the whole motivation for AM is uncertainty about how to achieve those objectives
- An AM process can be used to structure dialogue among stakeholders
  - But it is not, itself, designed to resolve conflicts

Clear management objectives



Graphic by Mike Runge, USGS

4. Value of information is high

- Uncertainty is the motivation for AM
- Uncertainty about how actions will affect management outcomes
- Reduction of uncertainty does not always lead to improved management
  - Uncertainty might not matter to the particular decision
  - The cost of reducing uncertainty might not be offset by the gains

Value of Information

- A formal concept from decision theory
- How much management is expected to improve if uncertainty is reduced
- VOI is high when
  - Different actions would be chosen under different hypotheses
  - The predicted outcomes are very different under different hypotheses
- More on this tomorrow…

Example 1: Low VOI

Number of Pairs		**Strategies**						
Hypothesis	Weight	Wait	No Salvage	No Disturb-ance	Restore Meadows	April DD & Burn	Kill Flies: Bti & WF	Swap older eggs
Too Young	9.4%	16	15	15	21	16	15	15
Black flies	29.1%	15	15	15	21	16	17	15
Social Conditioning	11.9%	16	16	16	22	16	16	16
Nutrient limitation: NNWR	22.8%	15	15	15	22	18	15	15
Nutrient limitation: winter	5.9%	15	15	15	20	16	15	15
Nutrient limitation: both	6.6%	15	15	15	20	17	15	15
Egg Salvage	4.4%	15	16	16	20	16	15	15
Disturbance	10.0%	15	15	15	21	16	15	15

Relative to this objective (maximize the number of pairs), the uncertainty about which mechanism is driving reproductive failure is irrelevant. Under all hypotheses, the same action (restore meadows) is optimal, so there is no value in resolving this uncertainty.

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Example 2: High VOI

Reproductive Success		**Strategies**						
Hypothesis	Weight	Status quo	No Salvage	No Disturb-ance	Restore Meadows	April DD & Burn	Kill Flies: Bti & DD	Swap older eggs
Too Young	9.4%	0.43	0.44	0.44	0.47	0.48	0.44	0.39
Black flies	29.1%	0.11	0.11	0.12	0.17	0.17	0.47	0.17
Social Conditioning	11.9%	0.14	0.17	0.18	0.18	0.16	0.14	0.16
Nutrient limitation: NNWR	22.8%	0.11	0.13	0.14	0.41	0.31	0.13	0.16
Nutrient limitation: winter	5.9%	0.09	0.12	0.13	0.22	0.21	0.11	0.13
Nutrient limitation: both	6.6%	0.07	0.09	0.12	0.26	0.22	0.1	0.12
Egg Salvage	4.4%	0.07	0.36	0.2	0.13	0.11	0.08	0.13
Disturbance	10.0%	0.09	0.13	0.33	0.21	0.12	0.11	0.09

Relative to this objective (maximize reproductive success), the uncertainty about which mechanism is driving reproductive failure is very relevant. Under different hypotheses, different actions are optimal, and the predicted differences in performance are substantial. There is a high value to resolving this uncertainty.

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Source: Runge MC, Converse SJ, Lyons JE. 2011. Which uncertainty? Using expert elicitation and expected value of information to design an adaptive program. Biological Conservation 144:1214-1223.

5. Testable models

- A hallmark of AM is the prior articulation of uncertainty, in the form of alternative models
  - Articulation of model forces all stakeholders to be explicit about their view of system dynamics
  - These models are then tested against the observed data
- Thus, AM requires the expression of uncertainty as a set of testable models

Sparse data?

- A common misperception is that development of an AM process requires a lot of data
- But, AM should be most useful precisely when there is a lot of uncertainty, that is, when there is little data
- Models can be qualitative and conceptual, if need be
  - They are meant to embody the intuitive models that decision-makers, scientists, and stakeholders have in their heads

6. Monitoring can be established

- The final condition is that a monitoring program can be designed and implemented that will resolve the relevant uncertainty
- The effectiveness of monitoring is important
  - Sample size
  - Expected treatment differences
  - Replication, randomization, control
- A realistic assessment of monitoring potential should be made to determine whether an adaptive program is likely to be successful

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Six Key Conditions

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Tools

- DOI Technical Guide Scoping Key
  - Checklist
  - Use when you are unsure if Adaptive Management is applicable to your problem.
  - Page *vi* of Technical Guide

Problem-Scoping Key for Adaptive Management

The following key can help in dissecting a particular management problem and determining whether adaptive management is an appropriate approach to decision making. If the answer to any question in the key is negative, then an approach other than adaptive management is likely to be more appropriate.

1. Is some kind of management decision to be made?
   (see Sections 1.1, 2.1, 2.3, 3.1, and 5.5)
   No – decision analysis and monitoring are unnecessary when no decision options exist.
   Yes – go to step 2.

2. Can stakeholders be engaged?
   (see Sections 1.1, 1.2, 2.1, 3.1, and 4.2)
   No – without active stakeholder involvement an adaptive management process is unlikely to be effective.
   Yes – go to step 3.

3. Can management objective(s) be stated explicitly?
   (see Sections 1.2, 2.1, 2.2, 2.3, 3.1, 4.2 and 5.1)
   No – adaptive management is not possible if objectives are not identified.
   Yes – go to step 4.

4. Is decision making confounded by uncertainty about potential management impacts?
   (see Sections 1.1, 1.2, 2.1, 3.1, 4.1, 4.2 and 5.2)
   No – in the absence of uncertainty adaptive management is not needed.
   Yes – go to step 5.

5. Can resource relationships and management impacts be represented in models?
   (see Sections 1.2, 3.1, 4.2, and 5.1)
   No – adaptive management cannot proceed without the predictions generated by models.
   Yes – go to step 6.

6. Can monitoring be designed to inform decision making?
   (see Sections 2.1, 2.3, 3.1, and 4.2)
   No – in the absence of targeted monitoring it is not possible to reduce uncertainty and improve management.
   Yes – go to step 7.

7. Can progress be measured in achieving management objectives?
   (see Sections 1.1, 3.1, 4.1, and 4.2)
   No – adaptive management is not feasible if progress in understanding and improving management is unrecognizable.
   Yes – go to step 8.

8. Can management actions be adjusted in response to what has been learned?
   (see Sections 1.2, 2.1, 3.1, 4.1, 4.2, 5.3, and 5.4)
   No – adaptive management is not possible without the flexibility to adjust management strategies.
   Yes – go to step 9.

9. Does the whole process fit within the appropriate legal framework?
   (see Sections 2.3, 2.4, 3.2, 4.1, and 4.2)
   No – adaptive management should not proceed absent full compliance with the relevant laws, regulations, and authorities.
   Yes – all of the basic conditions are met, and adaptive management is appropriate for this problem.