

Overview of Adaptive Management

- **What is Adaptive Management?**
- **How would it apply to the HCP ?**
- **Why is it necessary for an effective HCP in the Etowah basin?**

Resource

Adaptive Management

- A *process* for managing natural resources, in development since the 1960's
 - Distinctly different from commonly used management approaches
 - Widely recommended for addressing *complex problems in large systems*



US Fish and Wildlife Service/ National Oceanic & Atmospheric Administration

Addendum to the HCP Handbook (June 2001) -

Emphasizes use and integration of:

- Biological goals
- Adaptive management
- Monitoring
- Permit duration
- Public participation

Adaptive Management

**“Managing in the face of uncertainty,
with an emphasis on its reduction”**

- B. K. Williams and F. A. Johnson (1995)



The Case for Adaptive Management

The adaptive management process ensures that the managers can:

- Make the best possible decisions given the information available
- Continue to collect the information needed to manage as well as possible
- Adjust management within predefined bounds as information indicates better strategies



Adaptive Management

Acknowledges that “policies must satisfy social objectives, but also must be continually modified and flexible for adaptation” to “surprises”

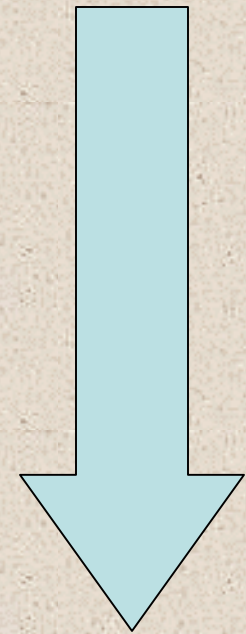


- L. Gunderson (1999)

Adaptive Management

Differs from traditional resource management (B. L. Johnson 1999) -

- **Political/social decision making**
- **Conventional-wisdom approach**
- **Best-current-data approach**
- **Monitor-and-modify approach**



**COMPLEXITY
& COSTS**

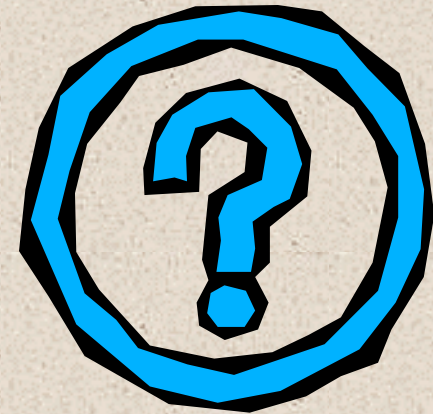
The problem: traditional approaches

- Don't explicitly integrate multiple resource management objectives well (as in complex problems, large systems)
- Don't explicitly recognize uncertainties inherent in resource management decisions
- Don't deal well with unexpected outcomes, "surprises"



Sources of uncertainty?

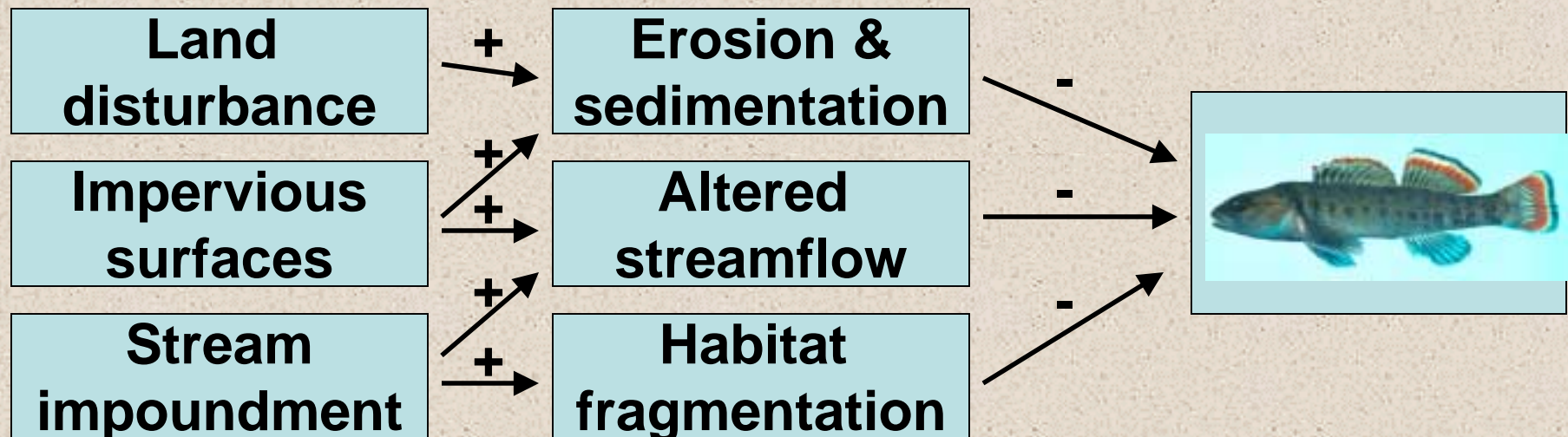
- **Structural (ecological) uncertainty**
- **Environmental variation**
- **Partial controllability**
- **Partial observability**



Sources of uncertainty?

- **Structural (ecological) uncertainty**

Responses of natural systems and processes to management actions are not completely known



Sources of uncertainty?

- **Structural (ecological) uncertainty**
- **Environmental variation**

Future conditions are not completely known, for example, with respect to :

- ***climate***
- ***societal demands***
- ***technological advances***

Sources of uncertainty?

- **Structural (ecological) uncertainty**
- **Environmental variation**
- **Partial controllability**
 - ***Management decisions are applied indirectly (i.e., through regulations). Actual outcomes are always uncertain (e.g., sediment runoff with E&S controls in place).***
 - ***Implementation uncertainty.***



Sources of uncertainty?

- Structural (ecological) uncertainty
- Environmental variation
- Partial controllability
- **Partial observability**

We can not perfectly know the status of the system; measurement uncertainty.



Seth Wenger (from left), David Walters, Mike Merrill and Bud Freeman take samples from the Enewah River. Photo by Peter Frey

Premise of Adaptive Management

- There is uncertainty in how our management actions will succeed in attaining objectives; reducing uncertainty could improve management
- We must make decisions anyway
 - with incomplete knowledge
 - periodically
- The system can and will be monitored



Adaptive management process-

1. Stakeholders explicitly state **management objectives**
2. Identify alternative **management actions**
3. **Predict the response** of the system to each alternative
4. Choose and implement the ***optimal*** decision
5. **Monitor** system response with respect to:
 - Management objectives
 - Predictions

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Adaptive Management

Management “involves a continual learning process that cannot conveniently be separated into functions like ‘research’ and ‘ongoing regulatory activities’...”



- C. Walters (1986)

Application to the Etowah HCP

1. **Steering committee (SC) formulates management objectives**
2. **SC identifies management alternatives***
3. **SC and TAC develop models that link management to outcomes**
4. **SC uses information from models to design and implement HCP ***
5. **SC implements a monitoring program ***
6. **At specified intervals, monitoring data used to re-evaluate models, HCP guidelines ***

Application to the Etowah HCP

1. **Steering committee (SC) formulates management objectives**

Objectives need to be:

- **Specific**
- **Reflective of stakeholder values**
- **Expressed in terms that can be evaluated using monitoring data**

Differing objectives?

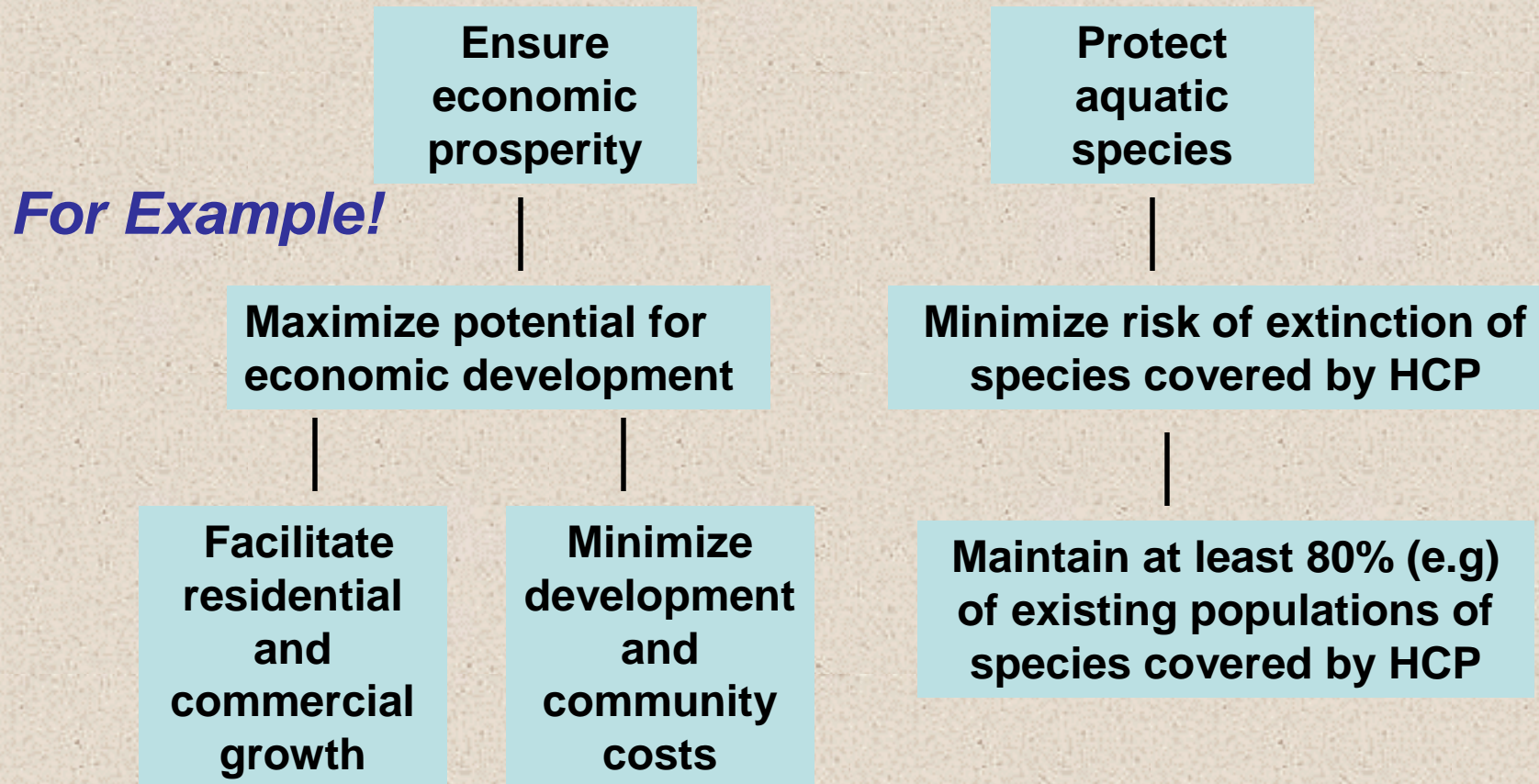
“Common currency” or use constraints

Fundamental objectives of Etowah HCP

“The Etowah Habitat Conservation Plan (HCP) strives to enhance the Etowah watershed through protection of aquatic species and water resources, ensuring continued economic prosperity and quality of life for future generations.”



Fundamental objectives of Etowah HCP



Objective: Facilitate diverse development while minimizing costs and maintaining at least 80% of existing populations of aquatic species covered by HCP

Application to the Etowah HCP

1. Steering committee (SC) formulates management objectives
2. SC identifies management alternatives

Process of identifying alternatives is underway -

e.g.,

- ***Alternative regulations*** for site design, storm water control, E&S control, subdivisions, riparian buffers
- ***Alternatives*** for where to allow different kinds and densities of development in the basin

Application to the Etowah HCP

1. Steering committee (SC) formulates management objectives
2. SC identifies management alternatives
3. **SC and TAC develop models that link management to outcomes**

About models:

- The goal of model building is *not* to make precise predictions about the future of fishes and the economy in the Etowah basin

- *“All models are wrong, some are useful.”*

- The goals are to

- Structure our understanding of the system

- Make explicit the gaps in that understanding

- Identify management approaches that may work

- *“Modeling is much too important to be left to modelers.”* F.E.A. Wood (1978)

Models:

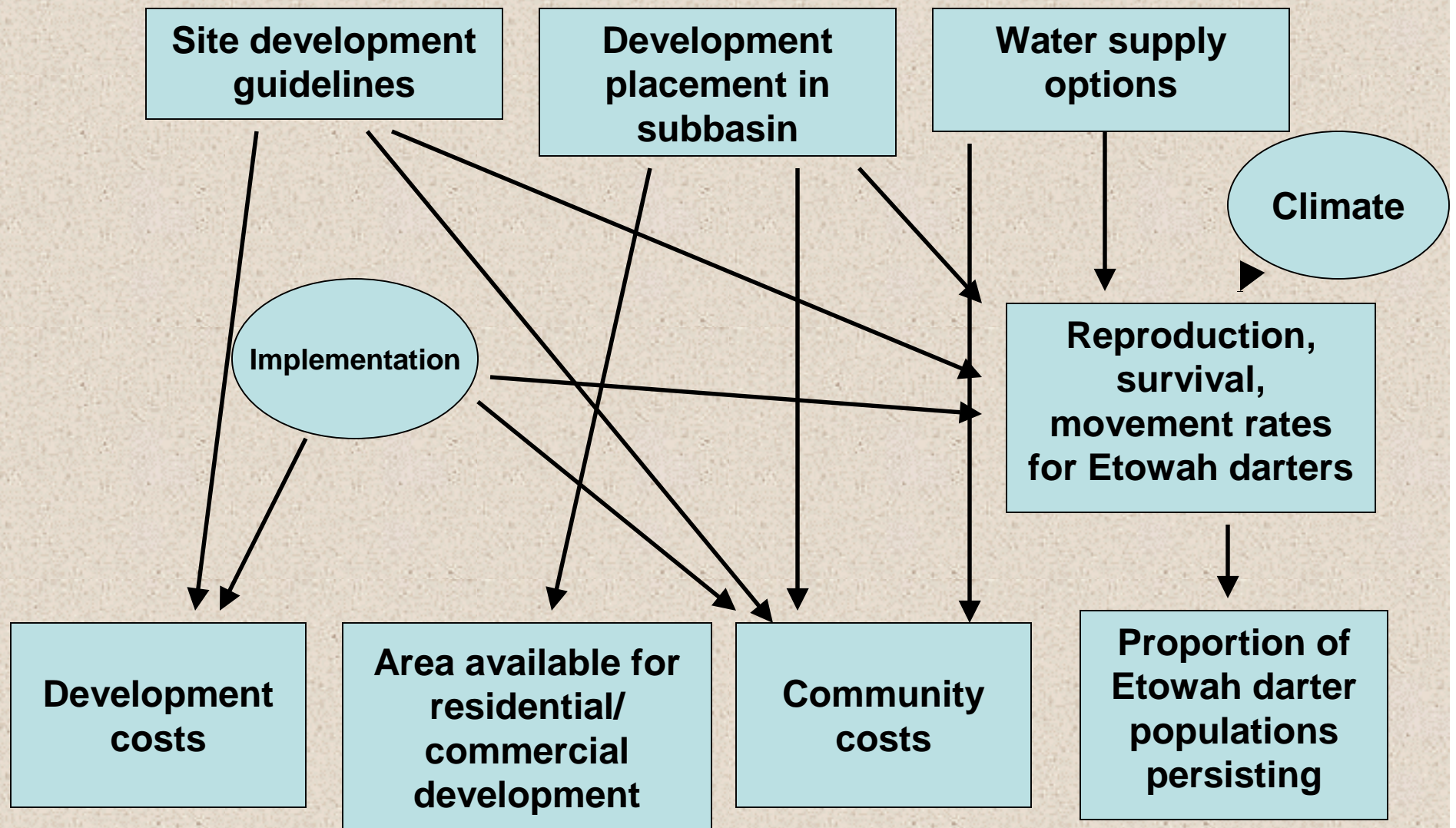
Quantitatively describe our best understanding of how management choices affect objectives

Are based on the best available data/understanding

Predict *likelihood* of attaining objectives for differing management strategies

Indicate what variables to monitor

An *example (!)* of a model for a subsection of the Etowah basin and a protected species



Models link options to outcome *likelihoods*

Site development guidelines, e.g.,

- Stormwater BMP's
- **Moderate control**
- Strict control

Development placement

- Zoning options (A vs B)

Water supply options

- **Multiple local systems**
- Regional reservoirs

EXAMPLE!

Implementation

Darter populations vs. stormwater control

Climate

Reproduction, survival, movement rates for Etowah darters

Development costs

	P
Low	40%
Moderate	50%
High	10%

Area available for res. development

	P
A lot	60%
Moderate	30%
V. little	10%

Community costs

	P
Low	20%
Moderate	50%
High	30%

% Darter pops persisting

	P
>80%	20%
60-80%	30%
40-60%	40%
<40%	10%

Application to the Etowah HCP

1. Steering committee (SC) formulates management objectives
2. SC identifies management alternatives
3. SC and TAC develop models that link management to outcomes
4. **SC uses information from models to design HCP *, which is implemented**

Management decisions are based on an explicit examination of alternatives, using the best available knowledge of the system, and in recognition of uncertainty associated with predictions.

Application to the Etowah HCP

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Implementation (how do regulations translate “on the ground”?)

Land use change (how does development proceed?)

Status of populations of covered aquatic species

Environmental variables that link populations to management actions/land use change

Social variables that link economic variables to management actions/land use change

Application to the Etowah HCP

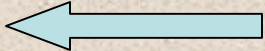
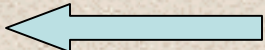
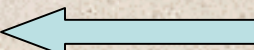
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6. **At specified intervals, monitoring data used to re-evaluate models, HCP guidelines ***

Use monitoring data to “update” models

Revise HCP terms if updated models indicate that:

- *current management will not protect covered aquatic species*
- *alternative management strategy will better attain objectives*

Independent scientific review is critical

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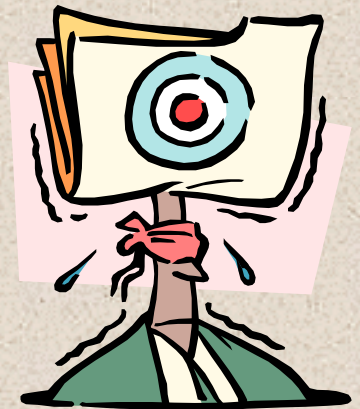
Why Not Adaptive Management?

- **Daunting time and workload investment (model construction and periodic evaluation)**
- **Large investment in monitoring**
- **Greater initial cost**
- **Requires institutional flexibility**



The Case for Adaptive Management

- No other management process can explicitly address *uncertainties* (ecological, economic, future conditions)
- Alternative: make best informed decisions with available information and hope for the best
 - Uncertain response if monitoring data show unanticipated losses of protected aquatic species
 - No opportunity to account for new, “environmentally friendlier” development practices in HCP requirements



The Case for Adaptive Management

- Management decisions are scientifically defensible
- By testing model predictions with monitoring data, we *reduce uncertainty*, allowing for better future decision making
- The process of monitoring, model updating, and re-evaluation ensures that the best decisions can continue to be made with respect to management objectives

