

# Meeting Your Monitoring Objectives



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# Outline for Today

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1. Define what environmental monitoring is and isn't
2. Describe typical objectives of environmental monitoring
3. Describe elements of effective monitoring strategies
  - Key is strong conceptual framework

# What is Environmental Monitoring?

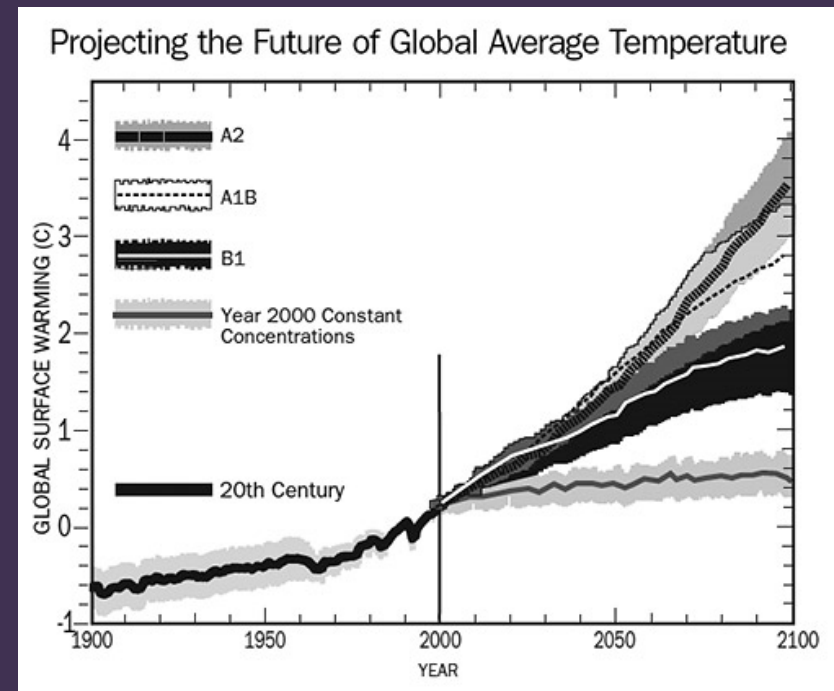
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- Monitoring is the planned, systematic collection of environmental data to meet specific objectives and environmental needs.
  - Monitoring provides information on linkages between changes in resource conditions and their causes.
  - Monitoring provides feedback related to management actions and provides a rational basis for future management actions.

# What Does Monitoring Provide?

The ultimate objective of a monitoring program is to develop the scientific understanding necessary for translating monitoring data into assessments of

- Current ecological condition (status)
- Predict future risks to a natural resource (trends).



# What are typical monitoring objectives?

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- Document baseline conditions
- Review the accuracy of predictions
- Monitor compliance
- Identify trends
- Assess the effectiveness of environmental protection measures and management regulations

# Not all Monitoring is of Equal Value

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.Lindenmayer, D. B. and G. E. Likens (2010). "Effective ecological monitoring."

## 1. Mandate Driven Monitoring

- Data must be collected due to a directive (government, legislative, etc.)

## 2. Question Driven Monitoring

- Driven by a conceptual model of the system
- Guided by experimental design and a priori predictions

## 3. Curiosity Driven Monitoring

- Often call mindless monitoring
- No questions, no study design, no objectives

# Mandate Driven VS. Question Driven

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## 1. Mandate Driven Monitoring

- Driven by broad and practical questions
- Usually post hoc
- Does not attempt to identify mechanisms causing change
- Focus on trends

## 2. Question Driven Monitoring

- Conceptual model of system provides predictions that can be tested
- Mechanisms can be discovered
- Management actions can be suggested and effectiveness measured
- Focus on outcomes

# What is not Monitoring

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- Simply measuring something
  - Curiosity is not enough
- Creating a predictive model or simulating future trends
  - This is something you test by monitoring
- Snap shots of a system
  - This can provide a baseline for monitoring
- Retrospective data evaluation
  - This can be used to make predictions to test with monitoring

# Effective Monitoring Includes:

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- A clear a simple statement of the monitoring question
- Selection of monitoring variables that provide:
  - Early warning of negative change
  - Early opportunity for taking management actions
  - Representation of both causes (manageable inputs) and effects (valued endpoints)
- A rigorous and repeatable sampling design
- Accurate analysis and interpretation of data

# Develop a conceptual framework before you start

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Monitoring simply to “know what’s going on”  
doesn’t cut it.

- Too vague and fails to generate clear objectives for effort

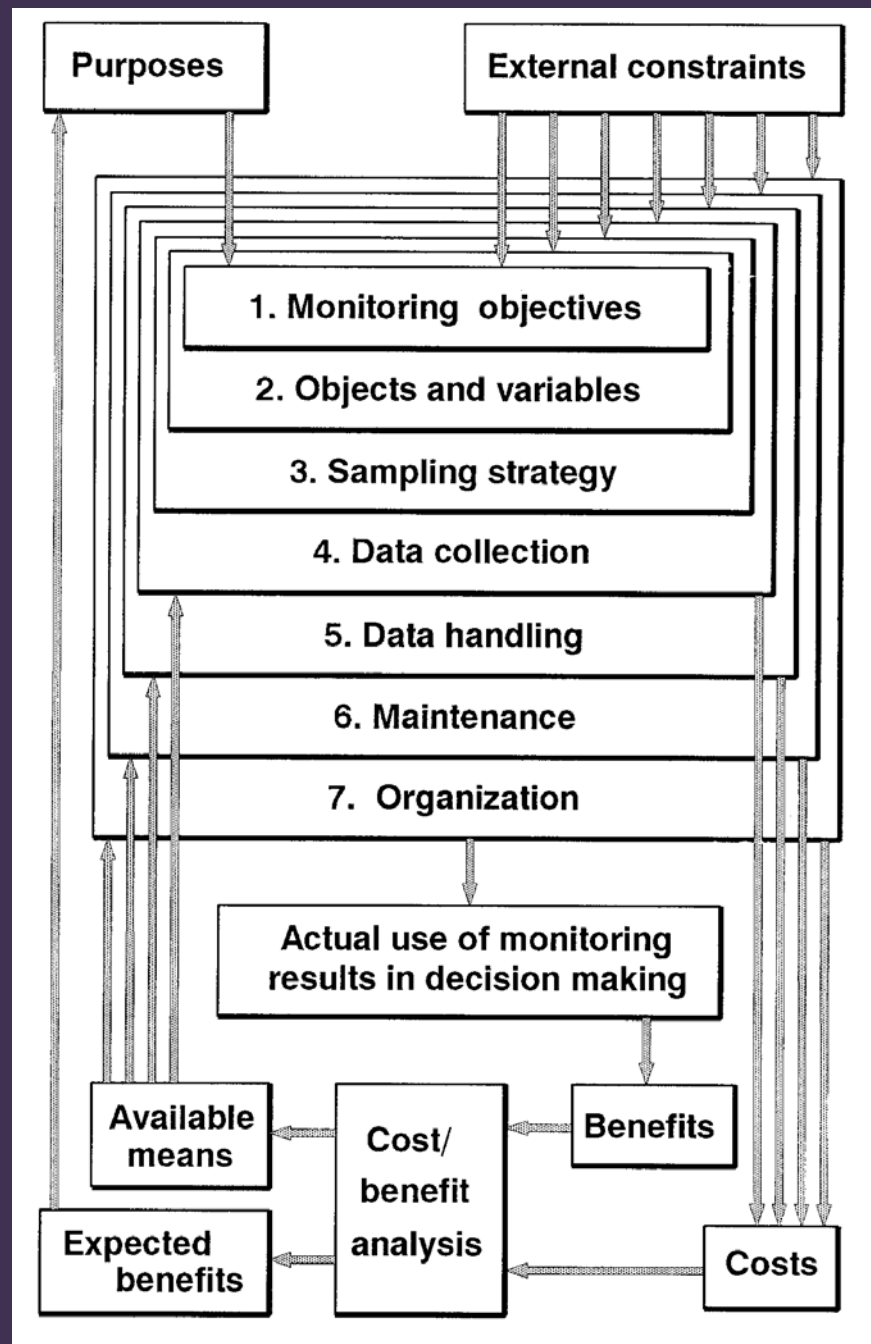
# Developing a conceptual framework before you start

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- Effective monitoring requires prior thought to expectations and goals, and the development of specific questions to be answered and methods of testing those questions
- Adoption of a rigorous framework will ensure that resulting management decisions or policy choices are less likely to be controversial and more likely to be accepted by interested parties (e.g., industry, the public)

- Establish a clear and scientifically sound path for achieving a monitoring program's desired outcomes
- Use the **KISS** philosophy whenever possible

**Keep It Simple Stupid!**



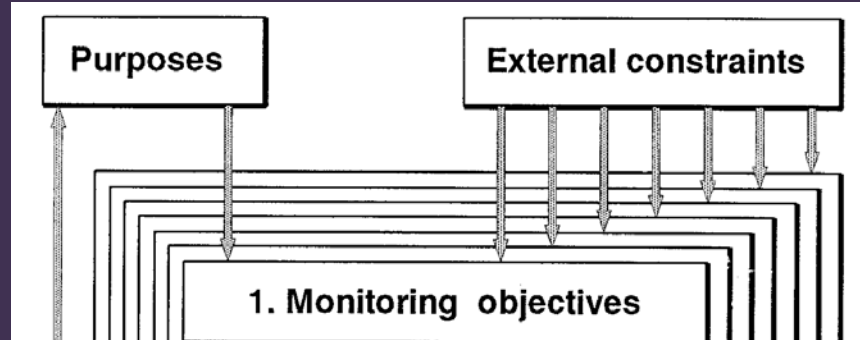
# What is your purpose?

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## Develop a one-sentence statement...

- To recognize environmental changes and analyze causes
- To measure adverse impacts and compare with predicted impacts
- To evaluate and improve mitigation measures
- To detect short-term and long-term trends
- To improve practices and procedures for environmental management...

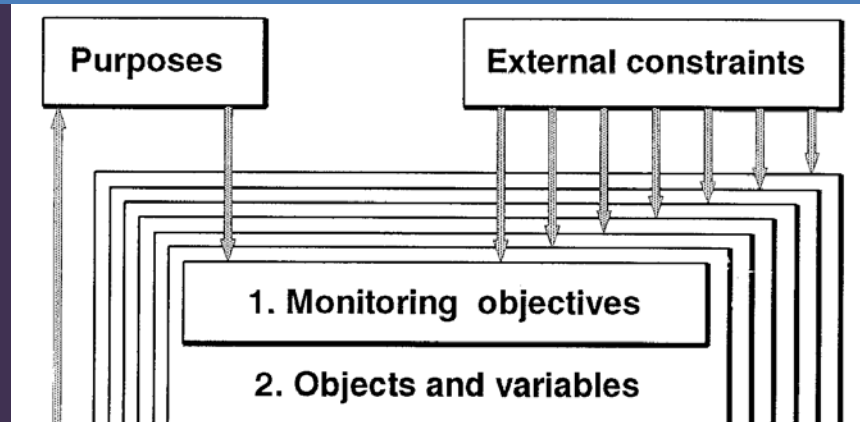
# Technical Components of Monitoring



## 1. Monitoring objectives

- Assessment of current state or conditions
- Detection of change

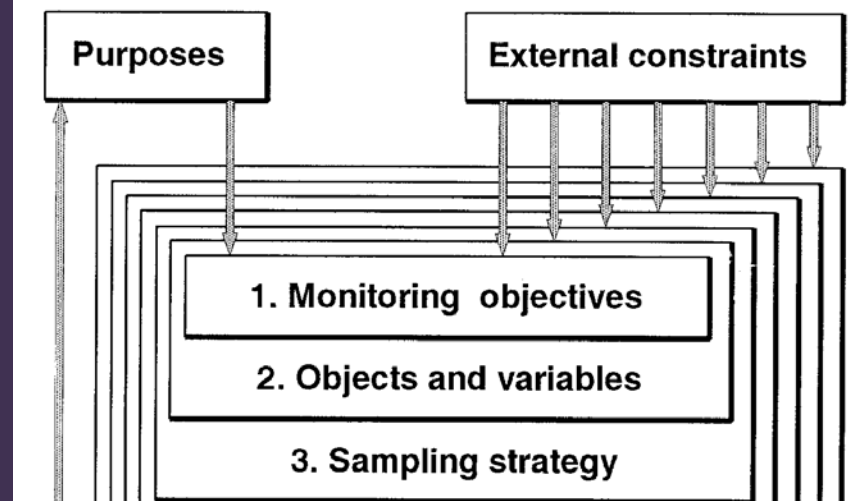
# Technical Components of Monitoring



## 2. Selection of variables to be measured

- Valued endpoints
- Early warning
- Indicators

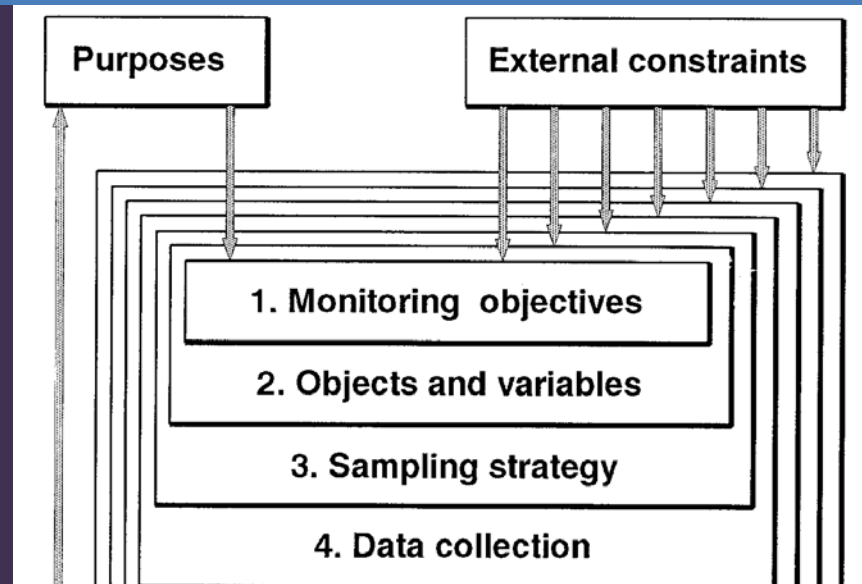
# Technical Components of Monitoring



## 3. Development of a sampling strategy

- Site selection
- Stratifications
- Statistical analysis
- Cause and effect

# Technical Components of Monitoring

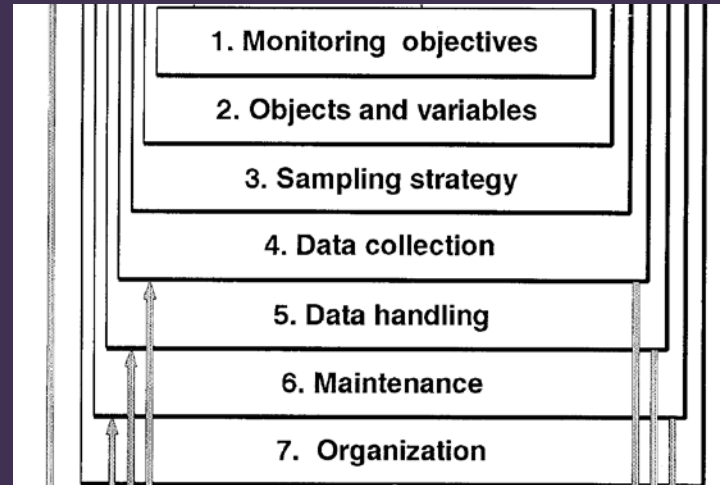


## 4. Data collection

- Optimization based on cost effectiveness relative to statistical power

What's the minimum effort needed to achieve adequate sample sizes for change detection or cause and effect detection?

# Technical Components of Monitoring



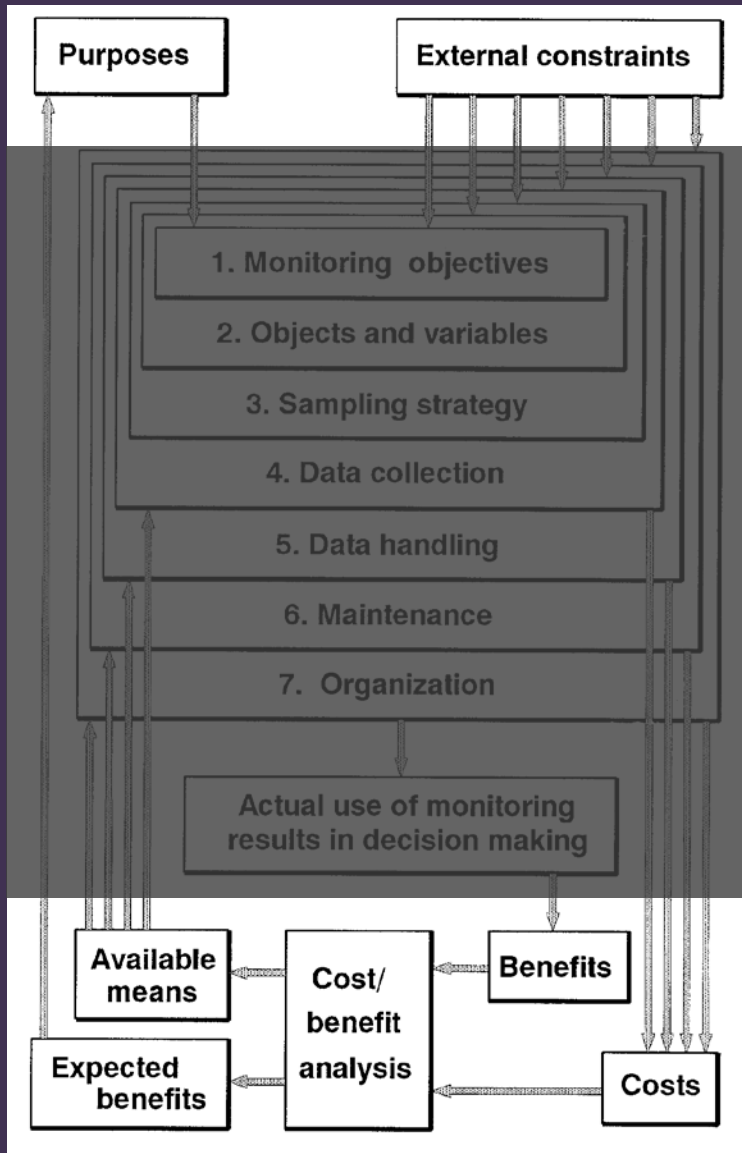
## 5. Data handling

- Data storage
- Statistical analysis
- Database access and management
- Presentation of results

## 6. Maintenance of monitoring effort

- Deliberate inclusion of program review and flexibility for modification and adaptation of framework

# Technical Components of Monitoring



7. Juggle all of this with external constraints and economic realities

# Why do we fail to meet objectives?

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- Failure to understand what a complete monitoring program is
  - Fix = Question based monitoring not curiosity or mandate based
- Failure to set clear objectives in the first place
  - Fix = Monitoring Framework with clear statement of questions and purpose
- Failure to carefully consider and select variables for best monitoring cause and effect
  - Fix = Clearly define the spatial and temporal scope and constraints of the monitoring question. What are the valued endpoints and what are the manageable inputs? Build sampling strategy around these features.

# Questions?

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