Introduction to Quantitative Decision Analysis and Adaptive Management for Fish and Wildlife (notes)

What is management?

- •Taking an action to obtain some desired resource outcome
- •Requires:
- •A range of alternative actions that can be taken
- •An objective we're trying to achieve

Management means making a decision

Decision definition: "an irrevocable commitment of resources"

Examples of decisions

- •Stock a reservoir
- •Set harvest regulations
- •Limit public access

Examples of not decisions

- •Set up a task force to study a problem
- •Establish a conservation priority list

Example decision

Objective: increase habitat availability to increase fish population

Decision: minimum flows

Model:

- If I increase flows, then habitat increases
- (Better) If I increase flows by X cms then habitat availability will increase by Y %
- (Even better) If I increase flows by X cms, habitat availability will increase by Y % and the population will increase by Z%

Fundamental assumption of this course: **All management is based on models!**

Lines of reasoning

1) Implicitly, choosing a decision (action) implies belief that a result will follow that tends to fulfill an objective
2) This belief can be described as a model of the decision's influence
3) Based on biological knowledge (research)
4) May be imperfect

Problems with Black Box Approaches to Management

- Generally not explicit or transparent
- Many unidentified and unstated assumptions
- MANY uncertainties
- Not transferable or repeatable
- No formal learning component

Sources of uncertainty on NR decision making

- Environmental uncertainty due to environmental and demographic variation
- Statistical uncertainty due to the use of sample data to estimate parameters
- Ecological (system) uncertainty due to incomplete understanding of system dynamics
- Environmental uncertainty due to environmental and demographic variation
- Statistical uncertainty

Quantitative Decision Making

- Stakeholder driven process)
- Management Actions
- External Physical Influences
- External Biological Influences
- Stakeholder Benefits
- The Basis of Adaptive Management

Why involve stakeholders?

- Natural resource decisions trust resources
- Multiple uses and competition
- Increase transparency
- Identify values and concerns among users
- Minimize or resolve conflicts
- Build public support

All decision makers are stakeholders

- Not all stakeholders are decision makers
- Decision makers legal authority/mandate to management resources

Several different styles of decision making

- Autocratic
- Consultative
- Democratic
- Consensus

Beware consultative decision-making

- May be good for public relations
- But… can lead to misunderstanding and conflict

Decision analysis process

- Identify the decision situation and objectives
- Identify the management alternatives
- Break down and build model of the problem:
- Identify the best alternative
- Evaluate model sensitivity
- Is further analysis needed?

- Implement the best alternative
- Adaptive management: special case of DA

We place a special emphasis on objectives because…

- Everything depends on your objectives
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Basic types of objectives

Fundamental objectives: what the decision-maker really wants to accomplish.

Means objectives: the things that need to be accomplished to realize the fundamental

Decision Making Process

Step 1: Identify the problem / decision situation

- Provides proper starting point and sideboards
- Focus on the big problem
    - decision-makers
    - spatial dimensions
    - temporal dimensions
- Identify the key elements of the problem
- Think creatively about the problem
- Get insight on the problem from others
- Revisit the problem throughout the process

Step 2: Identifying and Structuring Objectives

- Create a list of objectives
    - Personal objectives
    - What do you value?
    - What do you want?

    - What should you want?
- Strategic objectives
- Ultimate objectives
- Fundamental values
- Identify goals and constraints
- What are your ultimate aspirations?
- What are the external limits to achieving your goals?
- Do not let data or information availability limit your objectives!

Three very important phrases to use when structuring objectives

- Why Is That Important?
- How can you / I achieve that?
- What do you / I mean by that?

Identify and separate fundamental and means objectives using means objectives networks

Step 3: Identify decision alternatives

- What actions can be taken?
- Sometimes limited- legal mandates, restrictions within the authority of decision maker
- Should be mutually exclusive and exhaustive
- Can be a list of discrete actions, or the selection of an action over some continuous range (e.g., a harvest rate)
- Better to think creatively
- Better to develop exhaustive list of alternatives
    - then pare down
    - Often emerge as means objectives

Step 4: Model building

- Where do we get the information?

- Empirical data
- Published reports (meta-analysis)
- Construct the model (need to estimate the outcome!)
    - Simple (simple is good!)
    - Complex
- “Expert” judgment

Step 5: Identify key uncertainties--Sensitivity Analysis

- Prioritize research and monitoring
- Focus monitoring on decision-making
    - beyond power analysis (evidentiary)
    - what do we need to know
    - how much is enough
- Estimate value of information
    - collecting monitoring data
    - more studies

Learning how a system works

- Conduct additional studies/experiments
    - Time consuming (decisions can.t wait)
    - Expensive
    - Potentially wasteful
- Learn while managing (Adaptive Resource Management)
    - Decisions are made
    - Requires sequential dynamic decision-making: time and/or space

The process: Rapid prototyping

- Complete SDM process relatively short time
- Identify decision situation
- Objectives
- Mgmt. alternatives
- Create model

- Why rapid prototyping?
    - figure out if SDM is appropriate
    - identify roadblocks early
    - identify key uncertainties/data needs early
    - provide participants with idea of how it works

Ultimate goal of this course: to obtain the understanding and skills for developing quantitative decision models for conservation

Part 1: Identifying and structuring objectives
- Models as hypotheses
- Evaluation and interpretation of meaningful hypotheses
- Incorporating multiple hypotheses

Part 2: Model fitting, evaluation, and interpretation
- Prediction
- Simulation modeling
- Incorporating population models

Part 3: Decision model construction and evaluation
- Parameterization and optimization
- Sensitivity analysis
- Adaptive management