WFA8433-Natural Resource & Conservation Decision Making

Class 17 Objectives, Decision Models & Senstivity

Final Project

Final project information

Recall that the final report and presentation will be due during the final exam period

Final report sections

The bullets below represent the major and minor elements expected in the final report.

- MANAGEMENT PROBLEM
  - Spatial and temporal dimensions
  - Legal, regulatory, and institutional constraints
- STAKEHOLDERS
- OBJECTIVES
- DECISION ALTERNATIVES
- VALUATION OF OUTCOMES
- DECISION MODEL OVERVIEW
  - Nodes-Description of decision model nodes and states
  - Sensitivity analysis
  - Ecological context
- DISCUSSION
  - Value of the process
  - Future steps and lessons learned

Examples

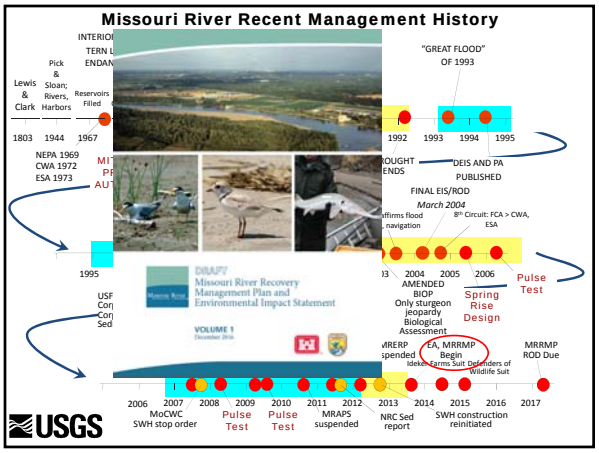
The pdfs below provide an example of the final report and presentation.

- Example final presentation
- Example final report

Applied Example

Monitoring Pallid Sturgeon in the Missouri River

TRIGGER AND PROBLEM



MRRMP-EIS Trigger

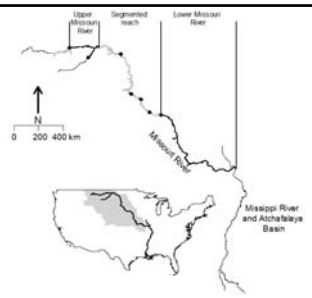
Includes an adaptive management plan…
you need to monitor…

"Aerial Missouri River Garrison Dam 32" flickr photo by North Dakota National Guard https://flickr.com/photos/ndguard/5817472262 shared under a Creative Commons (BY-NC-SA) license

MANAGEMENT PROBLEM

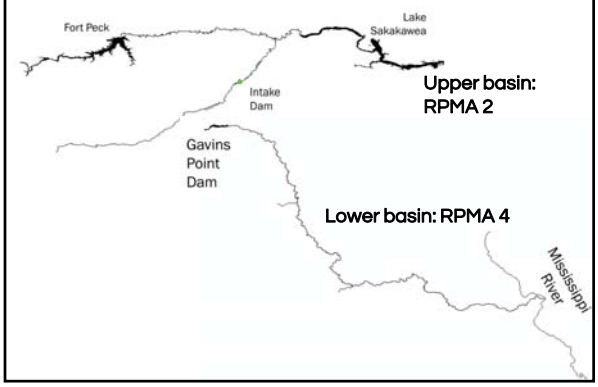
Problem

The recent implementation of the Missouri River Recovery and Management Plan in 2013 requires adaptive management plan to formalize learning and reduce uncertainty about the likelihood of alternative management actions to achieve fundamental objectives of the pallid sturgeon recovery. Although a catch per unit effort based monitoring program has been in place since 2003 it may not meet the fundamental objectives of the recovery program in RPMA 2 and 4. Therefore a refined population monitoring approach for pallid sturgeon may be needed so it is effective and efficient in meeting the information needs of the Missouri River Recovery Program. Information needs are defined in the MRRMP pallid sturgeon management objectives as affirmed jointly by the USFWS and USACE. Monitoring will be designed within the framework of the Missouri River Science and Adaptive Management Program (MRSAM), with emphasis on tracking population status, estimating key metrics and demographic parameters, and integrating/associating population responses with management actions over the next 20 years.

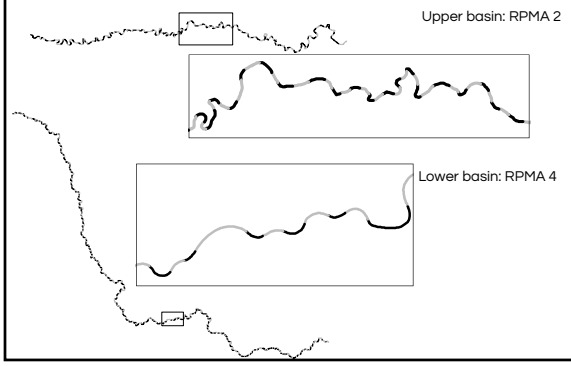


SPATIAL EXTENT

Spatial Extent



Spatial Grain



Legal, regulatory, and institutional constraints

The USACE, as the water management entity responsible for the Missouri River mainstem from Fort Peck Dam and Reservoir to the mouth and projects making releases to the lower Kansas River, has consulted with the U.S. Fish & Wildlife Service (Service) regarding the conservation of the pallid sturgeon.

STAKEHOLDERS

Stakeholders

Montana Fish, Wildlife & Parks

U.S. Fish & Wildlife Service

US Army Corps of Engineers.

South Dakota

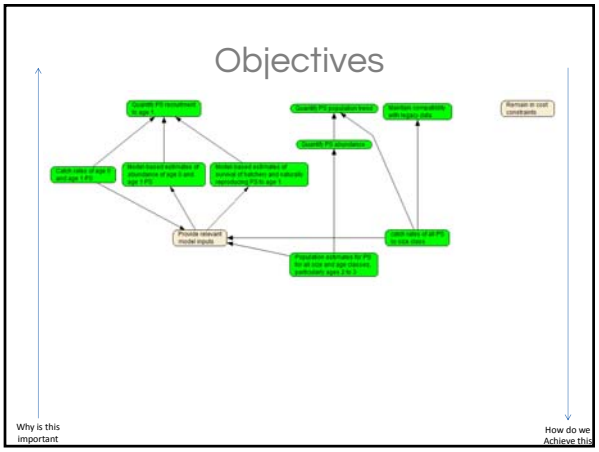
Nebraska Game & Parks

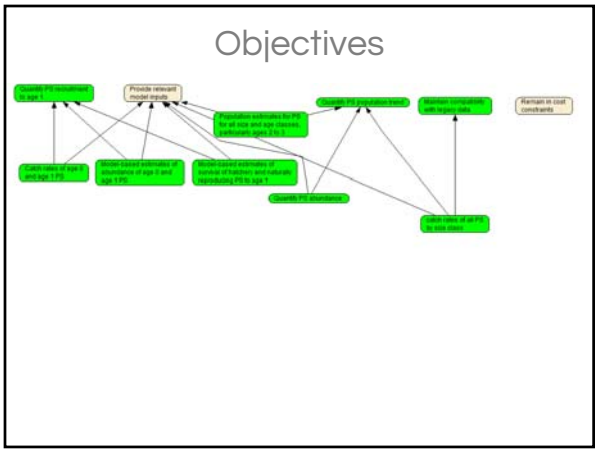
DNR

Missouri

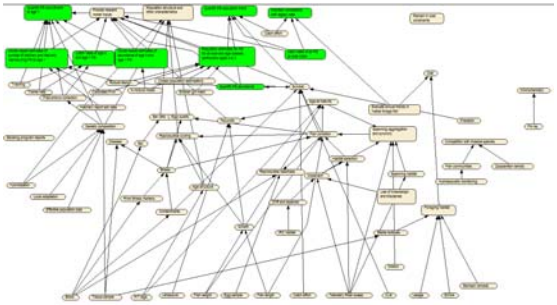

Objectives

OBJECTIVES


Objectives
Why is this important
How do we Achieve this

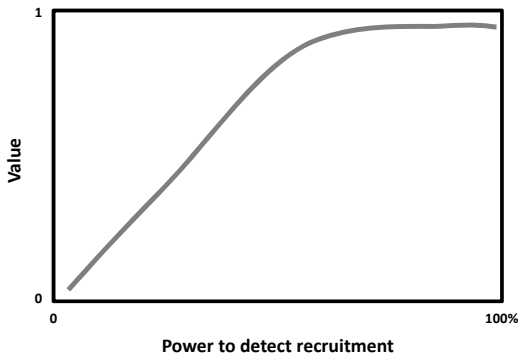

Objectives

Objectives hierarchy & influence

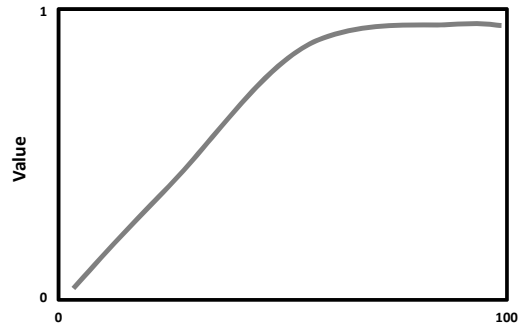


VALUATION OF OUTCOMES

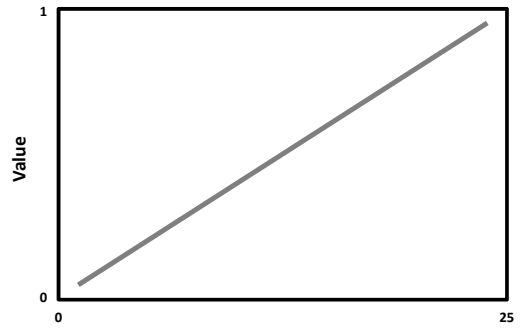
Quantify PS recruitment to age 1.



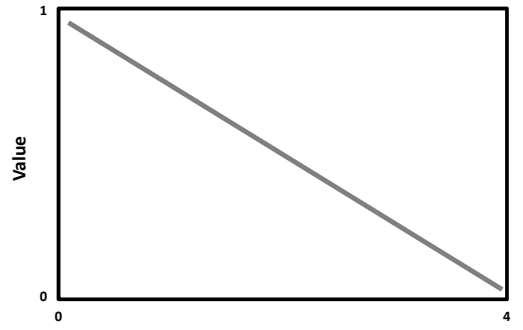
Quantify PS population trend



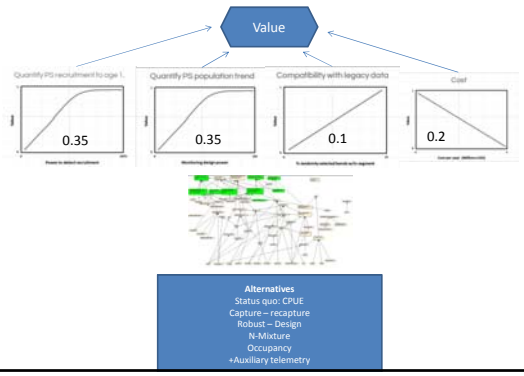
Compatibility with legacy data



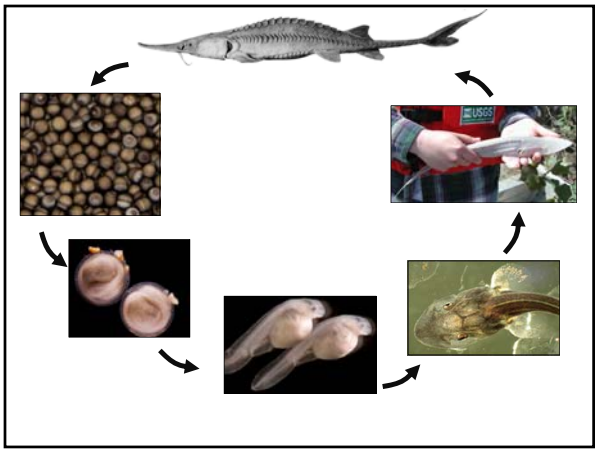
Cost

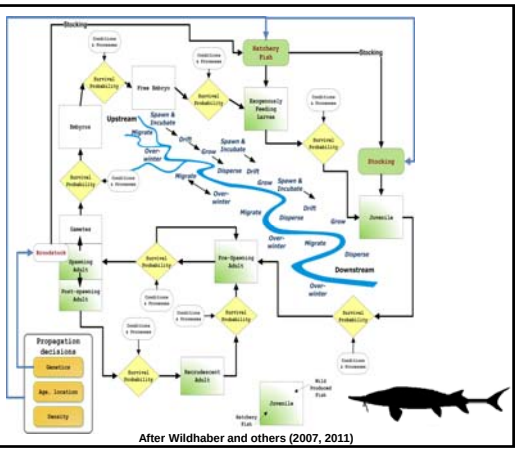


Valuation

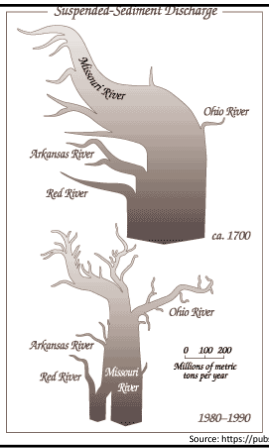


ECOLOGICAL CONTEXT





After Wildhaber and others (2007, 2011)

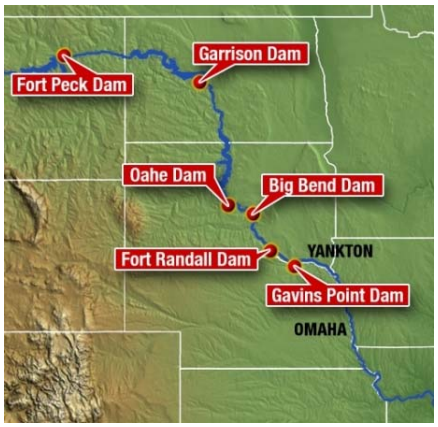


Source: https://pubs.usgs.gov/fs/fs-004-03/images/fig8.gif

Missouri River Authorized Purposes

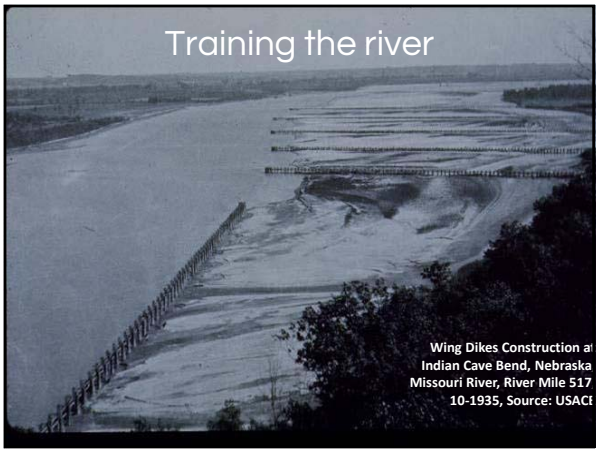
	Commercial Navigation tons transported	Flood Control	Irrigation	Power power generated by hydroelectric dams	Water Supply municipal and industrial purposes other than irrigation	Recreation	Fish and Wildlife	Water Quality
Anticipated Benefits from the Pick-Sloan Plan	5 million tons	System to be regulated to prevent flood damage on the downstream reaches of the river	5.3 million acres	718 MW	Minimal Expectations	Minimal Expectations	Not adequately considered	Not adequately considered
Actual Benefits	< 0.2 million tons (2006)	See Figure 6, flooding has increased	About 550,000 acres	2,991 MW (2009)	At least 1,600 intakes of varying sizes	$84.6 million (1998)	Highly degraded by Pick-Sloan alterations	Requires water treatment plants to filter pollutants and sediment
States that Benefit Most (Source: NAS 2002)	Missouri	Missouri	South Dakota	Nebraska, Minnesota and South Dakota	Nebraska and Iowa	North Dakota and South Dakota	Not Determined	Not Determined

Note: Commercial Navigation was the primary justification for the BSNP

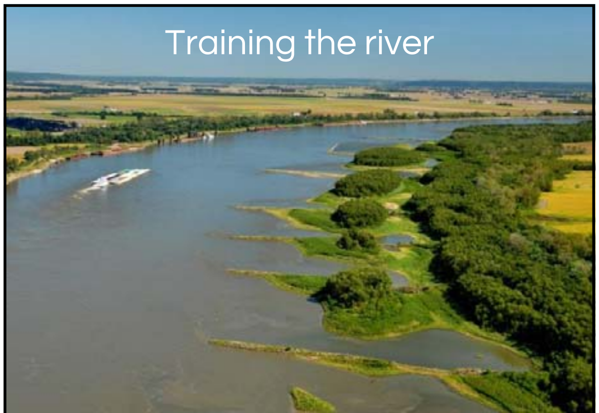


Source: https://www.greatbendpost.com/wp-content/uploads/2011/10/dams1.jpg

"Aerial Missouri River Garrison Dam 33" flickr photo by North Dakota National Guard https://flickr.com/photos/ndguard/5817472162 shared under a Creative Commons (BY-NC-SA) license



Training the river



Sourece:https://lh3.googleusercontent.com/CqCwB6CLbVPUjmpPjjM2aqNWlJktKuqYu_0ixajc5dR9zqCqBrMfhGncUJWIFvaZpL431SWYwWWCwvVJSGEUHpDZIU7gGp9QEHCTjCWeWGBOclB6UePH31lYhAThkWtxvpfcqWJeIAM

Habitat Restoration

"Channels of the Big Muddy" flickr photo by Plains and Prairie Potholes Landscape Conservation https://flickr.com/photos/plainsandprairielcc/8044354882 shared under a Creative Commons (BY) license

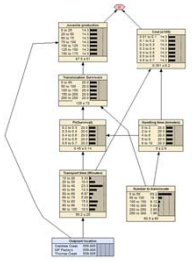
Habitat Restoration

Our next steps

- Refine objectives network
- Identify additional design alternatives
- Simulation of monitoring program alternatives
- Evaluate consequences & tradeoffs of alternatives to meet objectives
- Deal with uncertainty…

Objectives, Influence, and Sensitivity

Using the HW-3 parameterized network

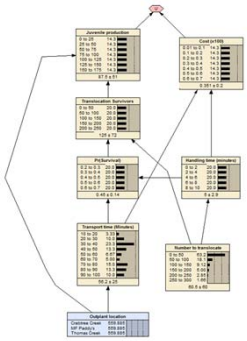


INFLUENCE DIAGRAMS

Objectives & Influence Diagram

- Fundamental and means objectives
- Framing decisions
  - Decision tree: Can get unwieldy…
  - Influence diagrams: Flexible

Influence diagram



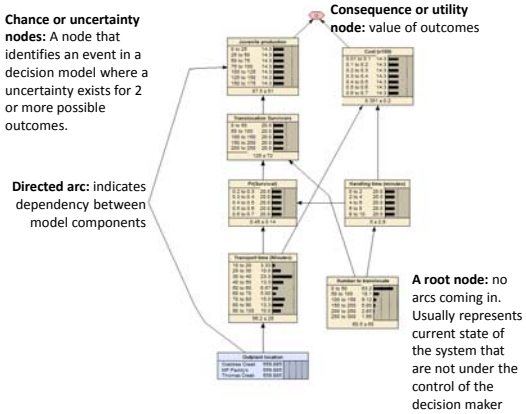
Why is this important

How do we Achieve this

Influence diagrams: Nodes

1. Decision
2. Uncertainty
3. Utility

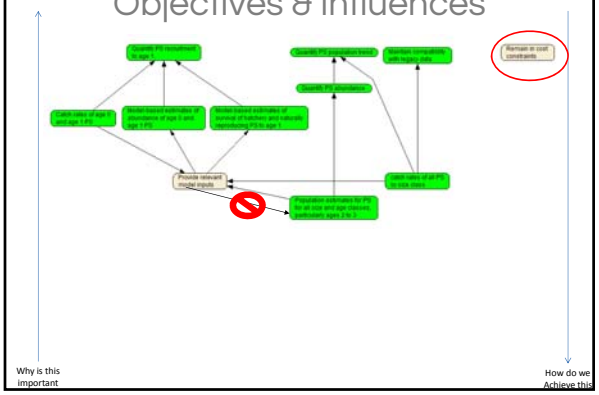
Connected by directed arcs



Common issues

- Not incorporating cost
- Failure to include important uncertainties or direct causal links
- Properly specifying the relationships among model components

Objectives & Influences



What if we don't have data?

- Best guess about the likelihood of outcomes
- Expert elicitation
- Total uncertainty-all outcomes equally likely, makes a challenge to make decision
- Simulation
- Meta analysis

Conditional probabilities

Current population size	Probability
Small	0.31
Medium	0.60
Large	0.06

Future Population	Small	Medium	Large
Small	0.8	0.15	0.05
Medium	0.1	0.8	0.1
Large	0.05	0.2	0.75

Future population size is influenced by Current population size

Combinations

- Curse of dimensionality
- All possible combinations
- More levels = lots of combinations
- 10 levels x 10 levels = 100 probabilities for possible outcomes
- Keep it simple… use few levels

Sensitivity Analysis

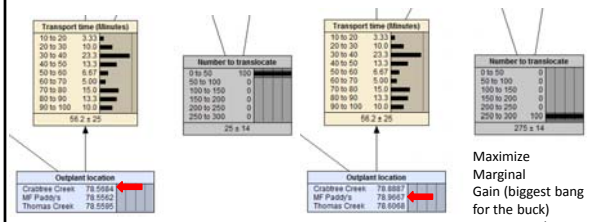
- What is important? In context of decision
  - Minimize or Maximize utility
- Inform monitoring
- Inform research

Sensitivity approaches

1. Tornado plot-1 way senstivity
2. Response profile

Tornado plot

1. Fix each node at highest and lowest value
2. Record value of optimal decision

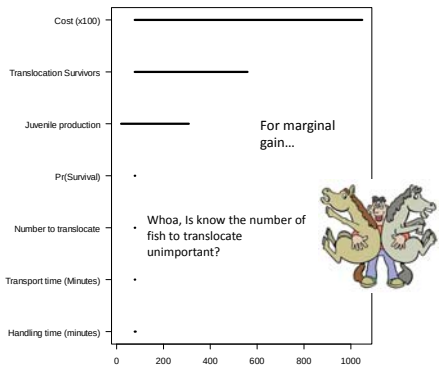


Maximize Marginal Gain (biggest bang for the buck) # produced/cost

Values for Min and Max of expected value

Node	Minimum	Maximum
Number to translocate	78.56	78.96
Transport time (Minutes)	78.66	78.57
Handling time (minutes)	78.63	78.58
Pr(Survival)	78.6	79.27
Translocation Survivors	78.53	559.89
Cost (x100)	78.48	1047.85
Juvenile production	308.76	18.72

Tornado Plot



Response profile

- Utility value for all levels of a node

Number to translocate	Crabtree Creek	MF Paddy's	Thomas Creek
0 to 50	78.57	78.57	78.57
50 to 100s	78.57	78.57	78.57
100 to 150	78.57	78.55	78.56
150 to 200	78.58	78.56	78.56
200 to 250	78.62	78.60	78.57
250 to 300	78.89	78.97	78.91

Response profile