University of Missouri

Week 1:

Course Overview & Introduction/ Motivation for Structured Decision Making

Instructor: Brielle K Thompson

Course: NAT_R 8001 Decision Analysis for Research and Management of Natural Resources

Who am I?

Brielle Thompson, PhD

- Postdoctoral Fellow at the University of Missouri
- Received PhD in June 2024 at the University of Washington (Advisors: Sarah Converse & Julian Olden)
  - Used decision analysis and mathematical/statistical population models to guide invasive species management
- Current projects:
  - Developing invasive Prussian carp monitoring protocols using simulation
  - Guiding invasive carp management decisions in the lower Mississippi River/ Arkansas Red-White Rivers
- Bills fan, dog Mom, distance runner

Introductions:

- Name
- Lab & Research
- Why are you interested in decision analysis/structured decision making?
- Fun hobby?

Logistics

- **Website (for most materials)**
  - This will be my permanent location for course material
  - Lectures and exercises will be posted on the website (not weekly readings)

- **Canvas (for grading)**
  - Use email/canvas to ask group questions
  - Grades will be posted on canvas
  - **Weeky readings will be posted on canvas (FILES folder)**

Timing:

- Weekly on Tuesdays until October 17th
- 2-4pm ABNR 210

Logistics – weekly schedule

*schedule subject to change

Week	Topic	PrOACT Step	Reading
1	Motivation for Structured Decision Making - Quick PrOACT Story	None- Introduction	Gregory et al. 2012 Chapter 1
2	Problem framing for natural resource decisions **Tools discussed:** Problem framing equation	**Pr**oblem framing	Runge et al. 2020 Chapter 2 (Smith)
3	Identifying and quantifying objectives for management decisions **Tools discussed:** Objectives hierarchy	**O**bjectives	Gregory et al. 2012 Chapter 4
4	Developing management alternatives and using models to identify the consequences of alternatives **Tools discussed:** Influence diagram, portfolios and strategy tables	**A**lternatives, **C**onsequences	Gregory et al. 2012 Chapter 7
5	Making tradeoffs amongst objectives **Tools discussed:** Multi-Criteria Decision Analysis, swing weighting	**T**radeoffs	Runge et al. 2020 Chapter 5 (Converse)
6	Decisions under uncertainty part 1 - **Tools discussed**: Decision trees, value of information	Advanced topic	Gregory et al. 2012 Chapter 10
7	Decisions under uncertainty part 2 and risk - **Tools discussed:** Adaptive management, risk profiles	Advanced topic	Gregory et al. 2012 Chapter 10 & Runge et al. 2020 Chapter 13 (Runge)
8	*Rapid prototyping student presentation (elevator pitch)*	All steps	

Logistics – Week 7 conflict

- Week 7 is currently October 7th
  - I will be attending TWS Annual Conference
  - Two options:
    - Extend class a week so the last week of class is October 21st
    - Have a guest lecturer for week 7 and keep final week of class as October 14th

Grading: Class graded out of 100

A (4.0) = 90-100
B (3.0) = 80-89
C (2.0) = 70-79
D (1.0) = 60-69
F (0) = < 60.

- Participation (40 points)
  - 5 points/week *see syllabus for grading
- Skills checks (28 points)
  - 4 points per week (weeks 1-7) *see syllabus for grading
- Final project –rapid prototyping (32 points)
  - *see syllabus for grading

Logistics – Final Presentation

During the final week of class, each student will be expected to informally discuss (~5 minutes) how components of decision analysis/ Structured Decision Making could be applied to their current graduate research project. The rapid prototyping grading rubric is found at the end of the syllabus.

- See syllabus for grading rubric
- We will revisit final project expectations most weeks

Course Learning Objectives

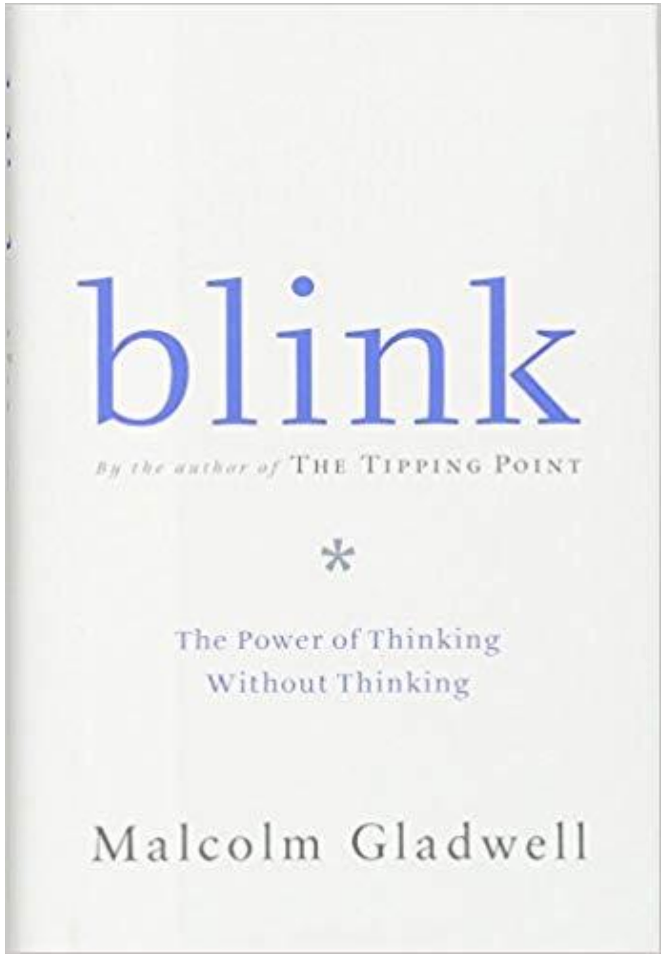
1. Identify the circumstances when Structured Decision Making could be useful
2. Comprehend key principles of Structured Decision Making (e.g., PrOACT, adaptive management)
3. Understand graphical models of natural resource decisions (e.g., objective hierarchies, influence diagrams, decision trees)
4. Identify tools that could be used for decision situations involving multiple objectives, uncertainty, risk, and repeated decisions
5. Apply the PrOACT process to graduate research topics with rapid prototyping

Week 1:
Introduction/ Motivation for Structured Decision Making

Humans are **GOOD Decision Makers**

US 1549, 15 January 2009

Blink



- Gladwell argues that our intuitive decision-making skills are excellent in certain circumstances
- Isn't the ability to make good decisions the hallmark of our species?

Humans are **BAD Decision Makers**

Quick Puzzle to Test Your Problem Solving

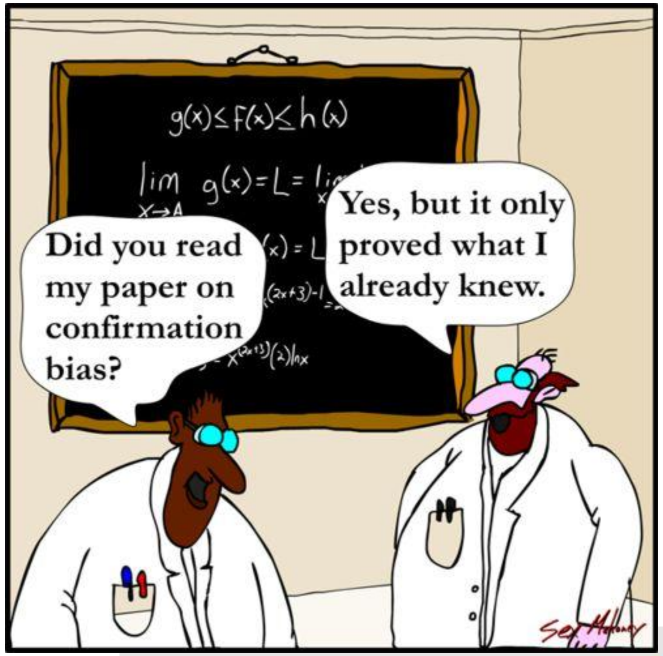
(Source: *The New York Times*)

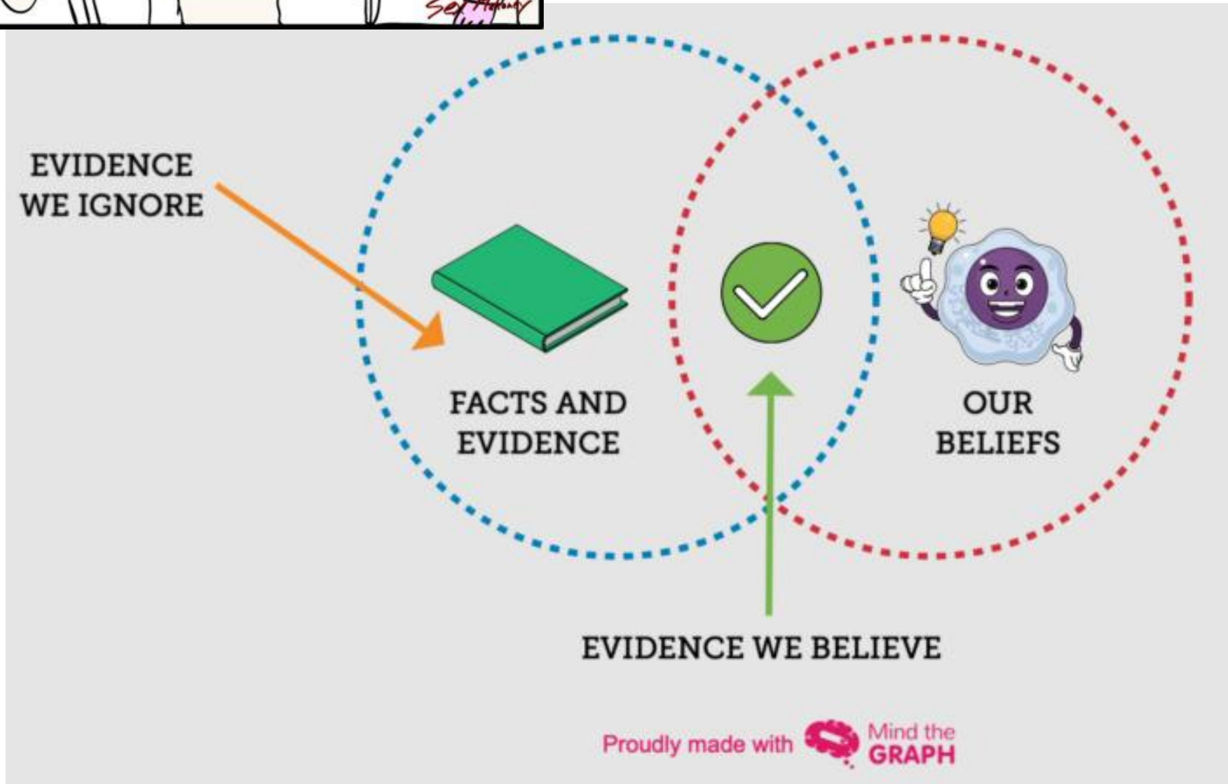
- I’ve chosen a rule that some sequences of three numbers obey — and some do not. Your job is to guess what the rule is.
    - The sequence: 1, 2, 4 obeys the rule.

- Give me 3 numbers and I will tell you if they obey the rule
- Can you describe the rule or do you want to test another sequence?

Cognitive Biases

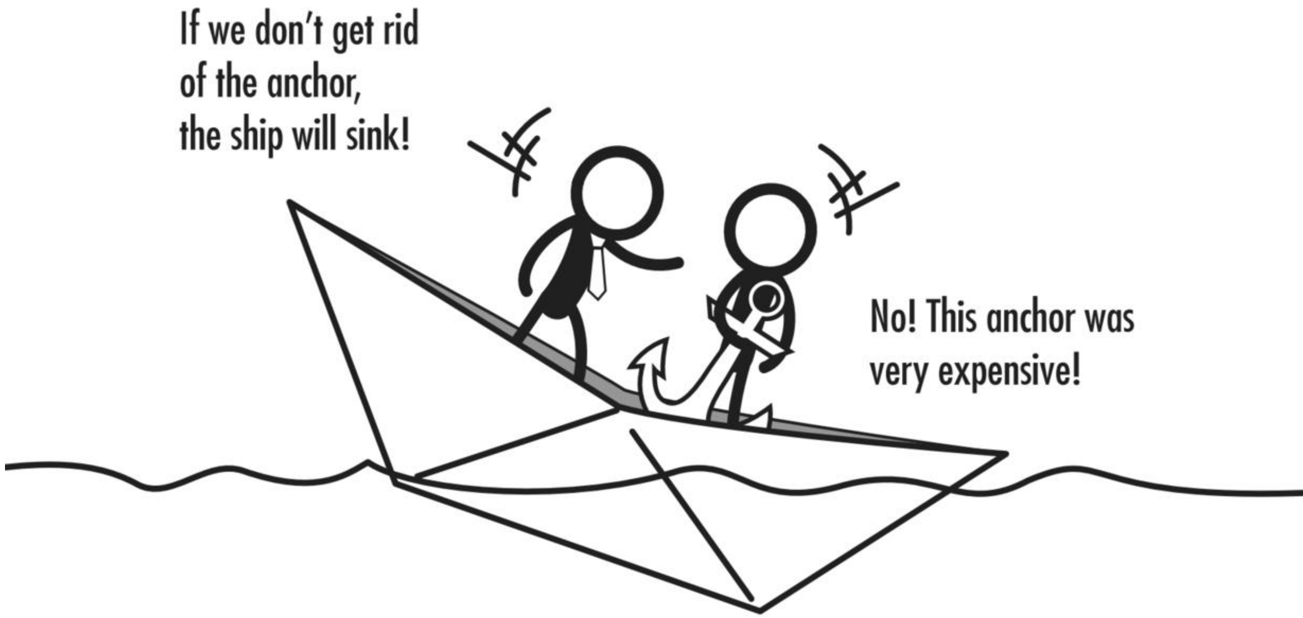
- **Confirmation bias**
  - Focusing attention on evidence that confirms your beliefs
    - *Example:* A policymaker who believes logging is harmful may ignore data showing that sustainable forestry practices can preserve ecosystems





Cognitive Biases

- Confirmation bias
- **Sunk costs**
  - Deciding based on past investments not future returns
    - *Example:* A marine conservation group invests heavily in a custom underwater drone system to monitor coral reef health. After deployment, they discover that the drones are unreliable in strong currents and produce lower-quality data than newer, off-the-shelf alternatives, but they continue to use their custom system.



Cognitive Biases

- Confirmation bias
- Sunk costs
- **Escalation of commitment**
  - Continuing to invest in a suboptimal choice
    - *Example:* Expanding a failing species reintroduction program to more regions, hoping it will eventually succeed and validate the original plan

Productivity Guy

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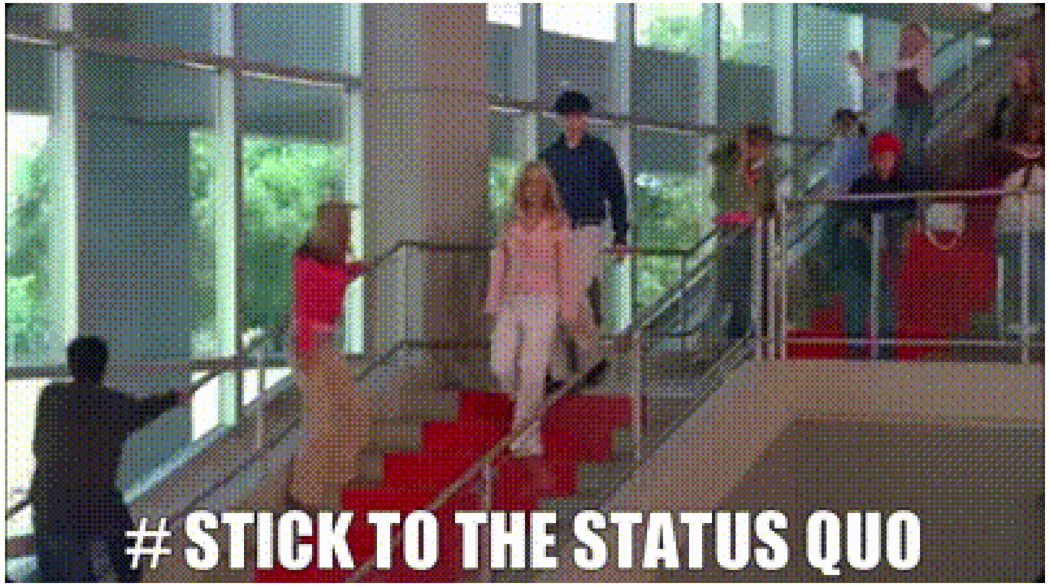
Cognitive Biases

- Confirmation bias
- Sunk costs
- Escalation of commitment
- **Status quo bias**
  - Preference to maintain current actions
    - *Example:* A farming region has used flood irrigation for decades, a method that consumes large amounts of water and leads to runoff and soil erosion. Despite the availability of more efficient technologies like drip irrigation, many farmers resist switching



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Quiz!

1,879 x 79 = ?

1,479,512

87 x 79 = ?

6,873

Errors in forecasting

- **Anchor and adjust**
  - We tend to anchor on the first piece of information and adjust
    - *Example:* A conservation team conducts a survey of a threatened bird species and estimates the population to be around 1,000 individuals. This number becomes the anchor for future discussions and planning. Years later, new surveys suggest the population may be closer to 600, but stakeholders and policymakers continue to base decisions on the original estimate

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Quiz

Which of these is more common?

A) People getting the stomach flu each year
B) People getting food poisoning each year

On average, more people per year get food poising vs the flu (Piedmont healthcare)

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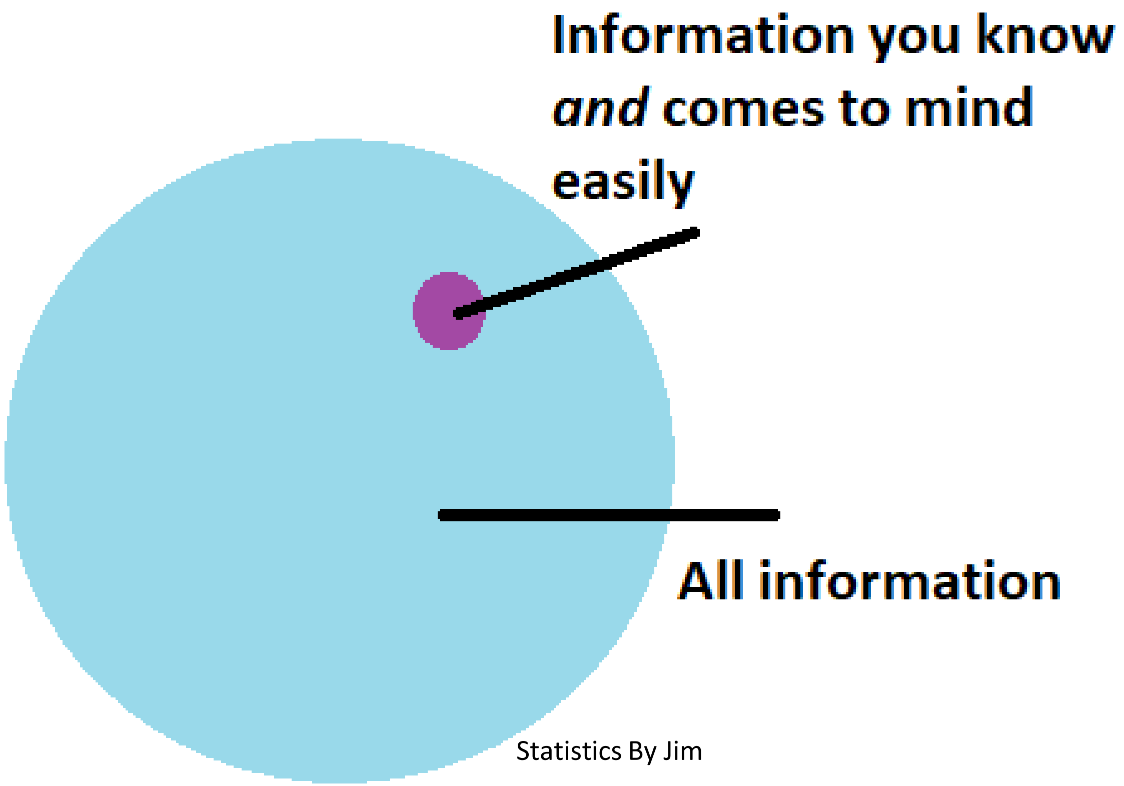
Errors in forecasting

- Anchor and adjust
- **Availability heuristic**
  - Judge the probability of events by the ease of recall
    - *Example*: After a high-profile wildfire receives extensive media coverage, a local government rushes to implement strict fire suppression policies across all forested areas, even in regions where fire is a natural and necessary

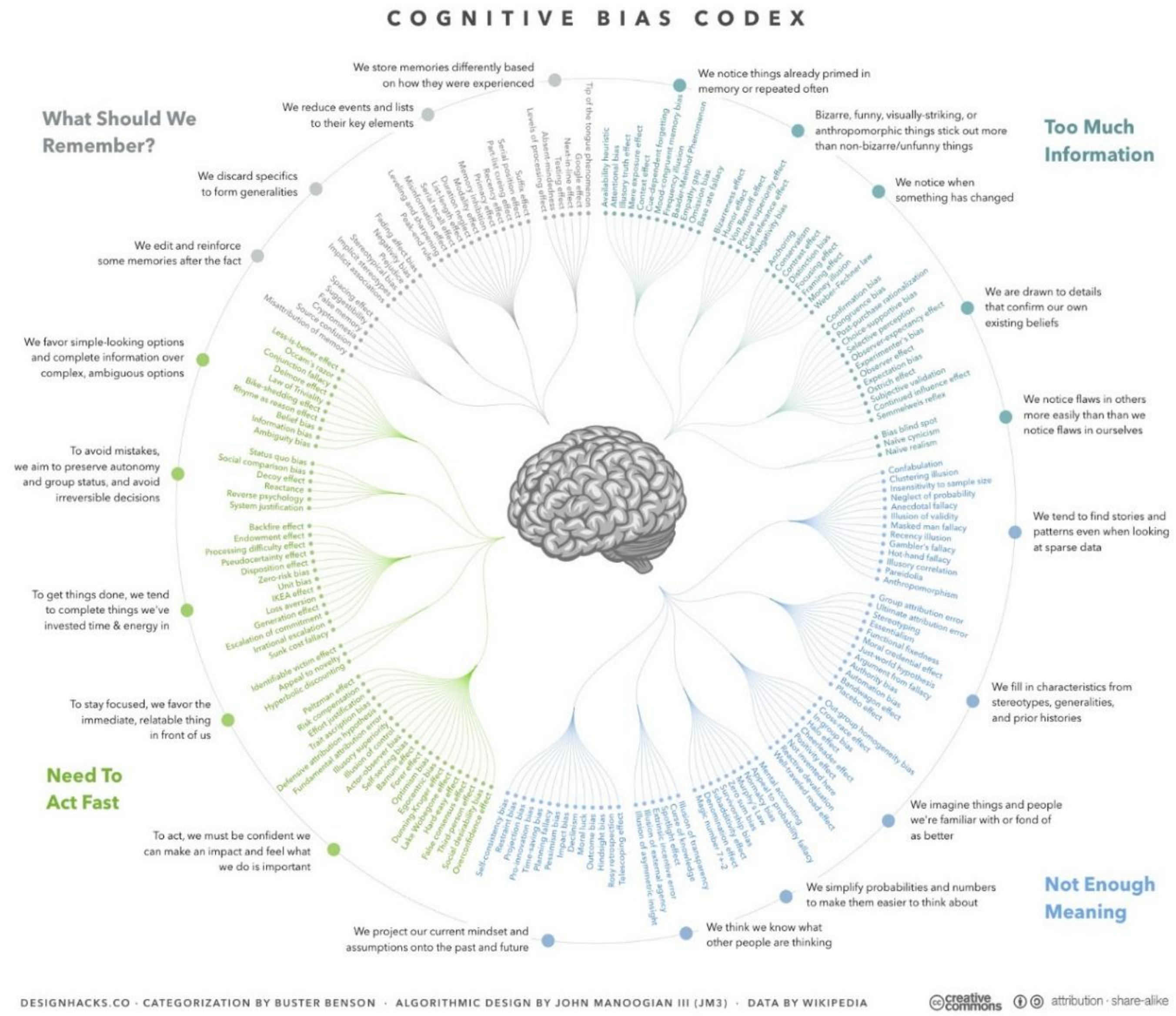


Errors in forecasting

- Anchor and adjust
- Availability heuristic
- **Representativeness heuristic**
  - Judge the probability of an event by the extent to which it resembles a typical case
    - Example: After experiencing five consecutive dry years, a conservation planner assumes a wet year is "due" soon, and delays implementing strict conservation measures.

Critical Thinking

Cognitive Biases



Activity: Cognitive Biases

- Read the following statements:
  - “We’ve always used this method to manage the forest”
  - “We saw a documentary about coral bleaching, so we need to focus all our efforts on reef conservation”
  - “We’ve already spent $2 million on this wildlife corridor”

Discuss in groups:

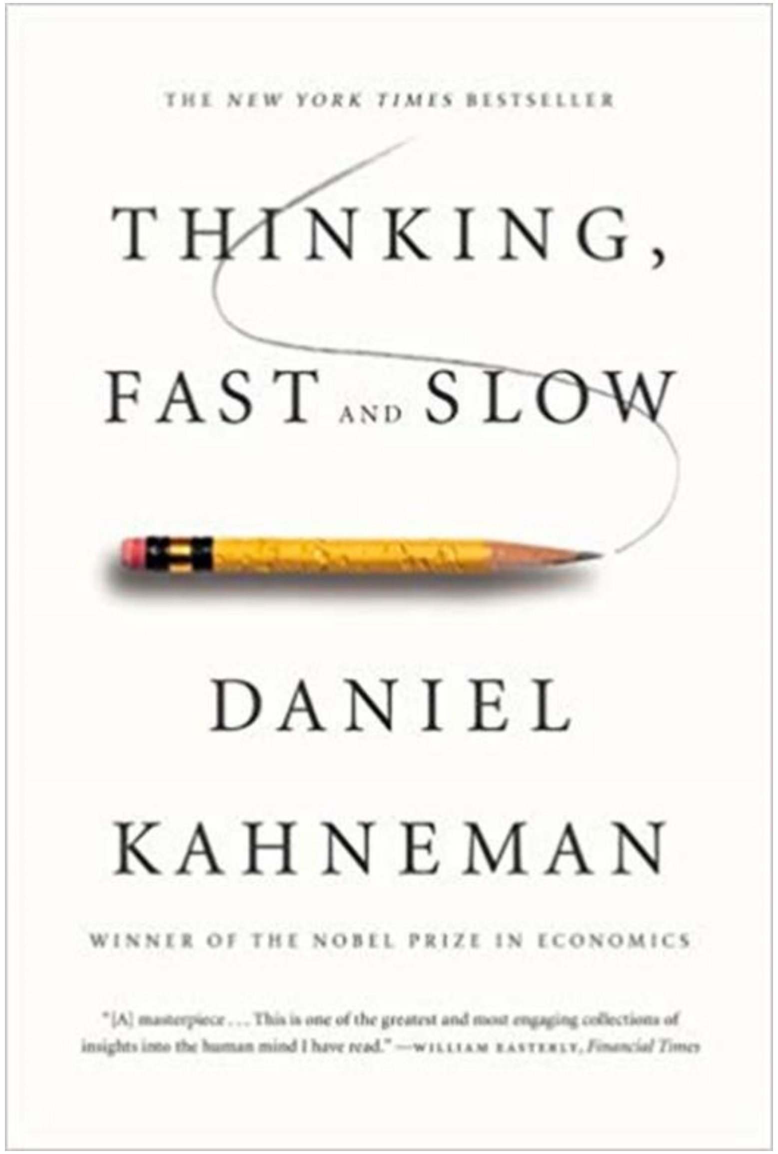
- Identify the type of bias
  - status quo/sunk cost/availability heuristic
- How might these biases affect conservation decisions?

Humans are both

GOOD and BAD decision makers

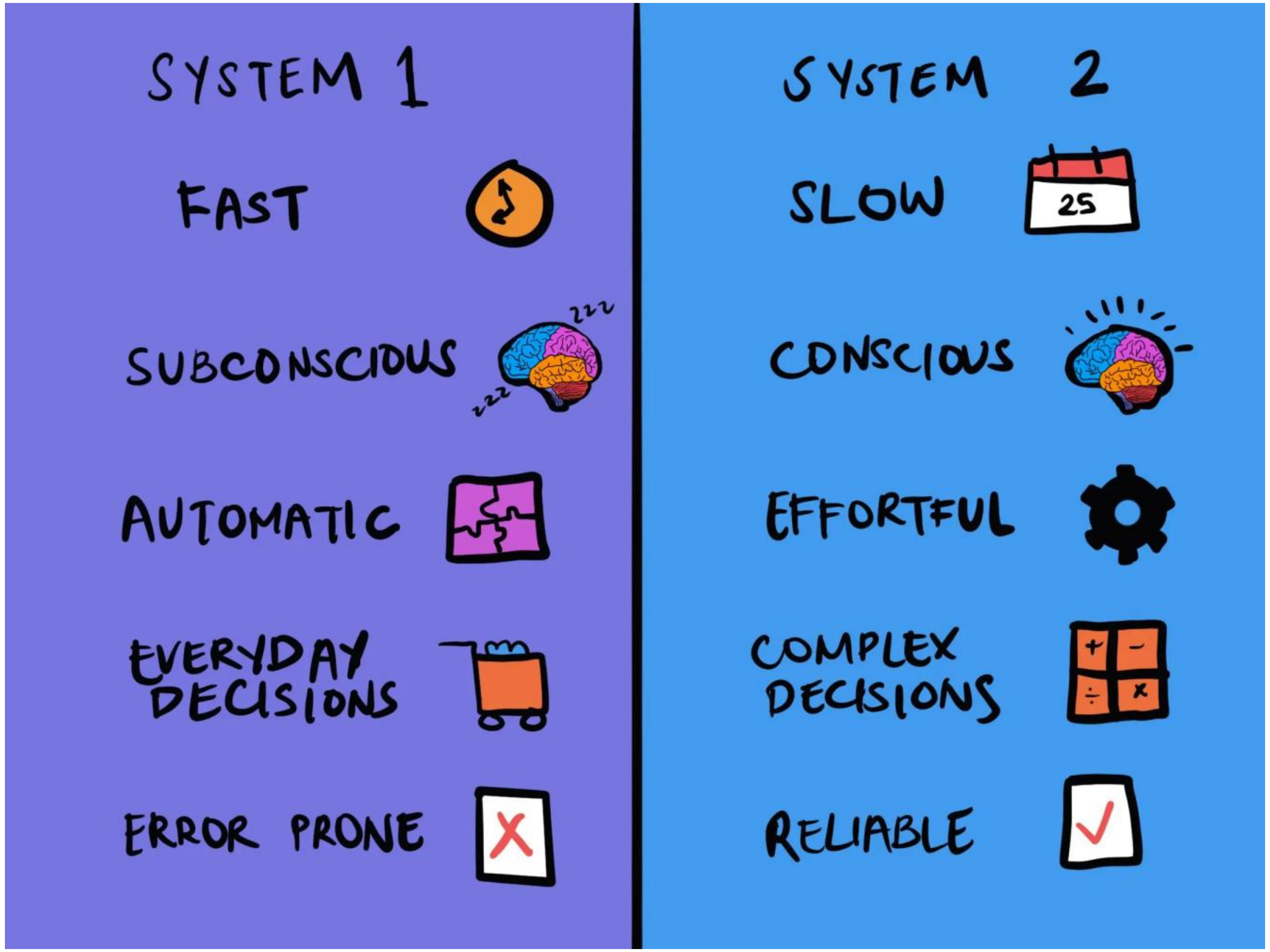
Human Decision Making

- **Daniel Kahneman** won the 2002 Nobel Prize in Economics for work he did in partnership with Amos Tversky on how people make decisions



Systems 1 and 2

- Kahneman and Tversky postulated that we have two cognitive systems



The Decision Lab

Activity: System 1 and 2 Thinking

Natural resource scenario: A coastal town relies on fishing for income

- System 1 response:
  - “Let's catch as many fish as we can while they are here”
- System 2 response:
  - “Let’s monitor its population and set quotas to ensure sustainability”

The fishing community of Sitka, Alaska

NOAA Fisheries/Marysia Szymkowiak

Discuss in groups:

- What are the short-term benefits of system 1 thinking?
- What are the long-term consequences of system 1 thinking?
- What are the pros/cons of system 2 thinking?

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Developed by Brielle Thompson

Typical approaches for hard decisions (system 2) in natural resources

Science-based decision making

- Use of scientific experiments to solely inform decisions
- Pros:
  - Used for "science" based decisions
- Cons:
  - "Science provides no basis for dealing with moral or value-based choices"

Consensus-based decision making

- Often uses deliberation practices to bring a group to a consensus agreement
- Pros:
  - Gets to an end point quickly
- Cons:
  - Doesn't solve the root of conflict
  - Conflicting views are thought of as "problems to be hushed"

Economic-based decision making

- Often uses economic techniques to translate a problem to monetary units to identify the least costly approach
- Pros:
  - Analytical and creates scores for each potential action
- Cons:
  - Does not typically involve scientific components
  - Transforms everything to $s

Developed by Brielle Thompson & See Week 1 reading (Gregory et al. 2012 Chapter 1)

A good approach for hard decisions (system 2) in natural resources

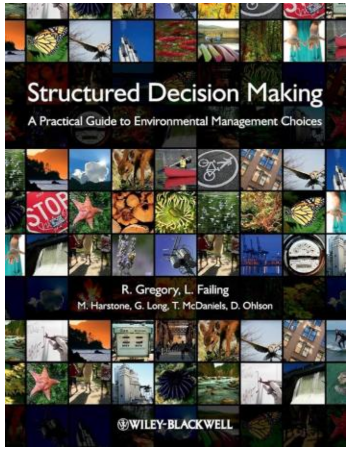
Structured Decision Making (SDM)

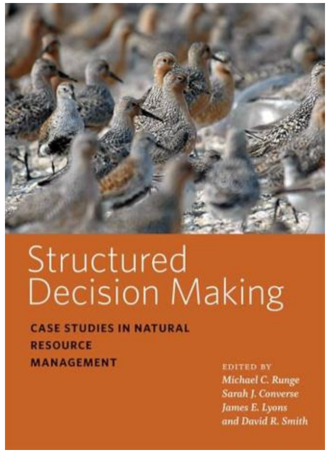
- "An organized, inclusive, and transparent approach to understanding complex problems and generating and evaluating creative alternatives"
- Pros:
  - Provides an in depth understanding of values (what is important) and consequences (what is likely to happen if an alternative is implemented)
  - Clarifies actions and their implications across a range of relevant concerns (your values)
- Cons:
  - Doesn't assure a good result *(but no decision frameworks can do this!)*
    - But SDM helps inform a "sound decision process" where you will "1) Do better in the long run than if you do not, & 2) Be in a position to defend your decision even if results are poor" (Conroy and Peterson 2013)

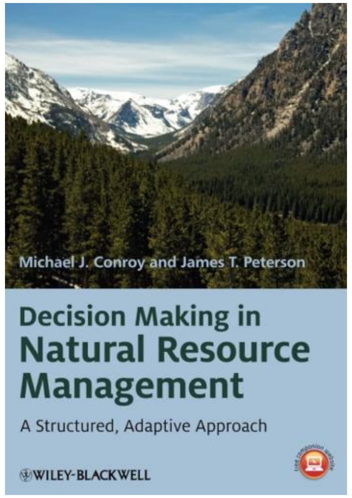
Developed by Brielle Thompson & See Week 1 reading (Gregory et al. 2012 Chapter 1)

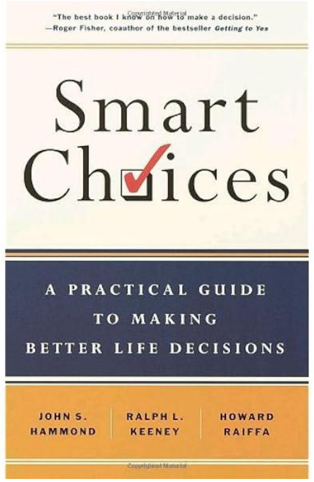
Structured Decision Making (SDM)

- Leverages our system 2 brain
- **Structured Decision Making** refers to the use of the principles of normative decision theory
  - Normative decision theory: studies how people <u>should</u> make decisions
- Decision analysis is ***"a formalization of common sense for decision problems which are too complex for informal use of common sense."***
  - Decision Analysis and Structured Decision Making (SDM) are synonymous









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Two key elements of Structured Decision Making

1. Values-focused

- Objectives are discussed first
- Contrasts with alternative-focused methods

2. Problem decomposition

- Break problem into components, separating science from values
- Complete relevant analysis
- Recompose the parts to make a decision
- PrOACT

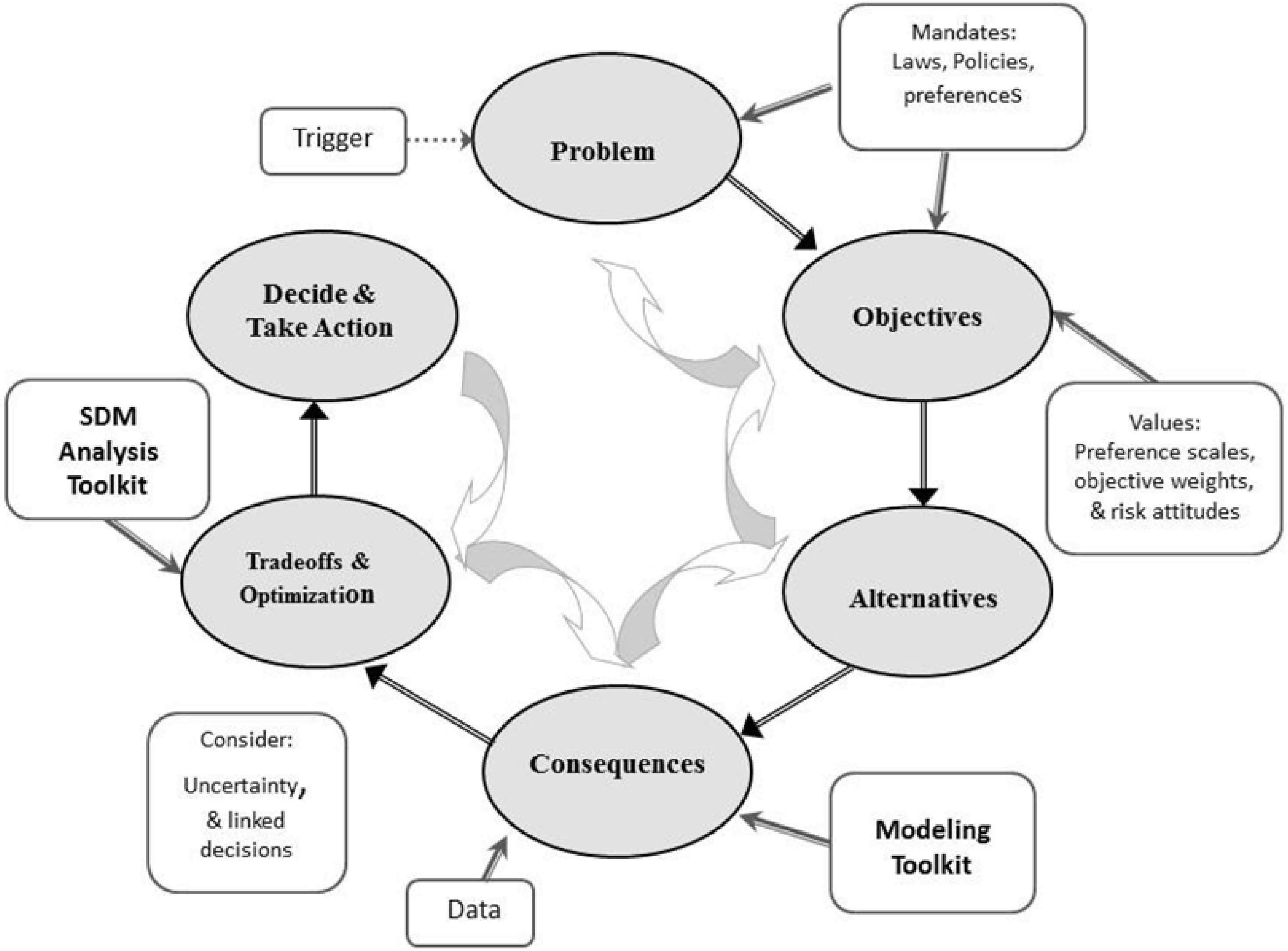
Developed by Michael C. Runge

PrOACT

- Define the **Problem**
- Determine the **Objectives**
- Identify **Alternatives**
- Forecast the **Consequences**
- Evaluate the **Trade-offs**

Additional steps

- Return to previous stages
- Sensitivity analysis
- Make the decision
  and monitor the outcome



Source: Jean Fitts Cochrane

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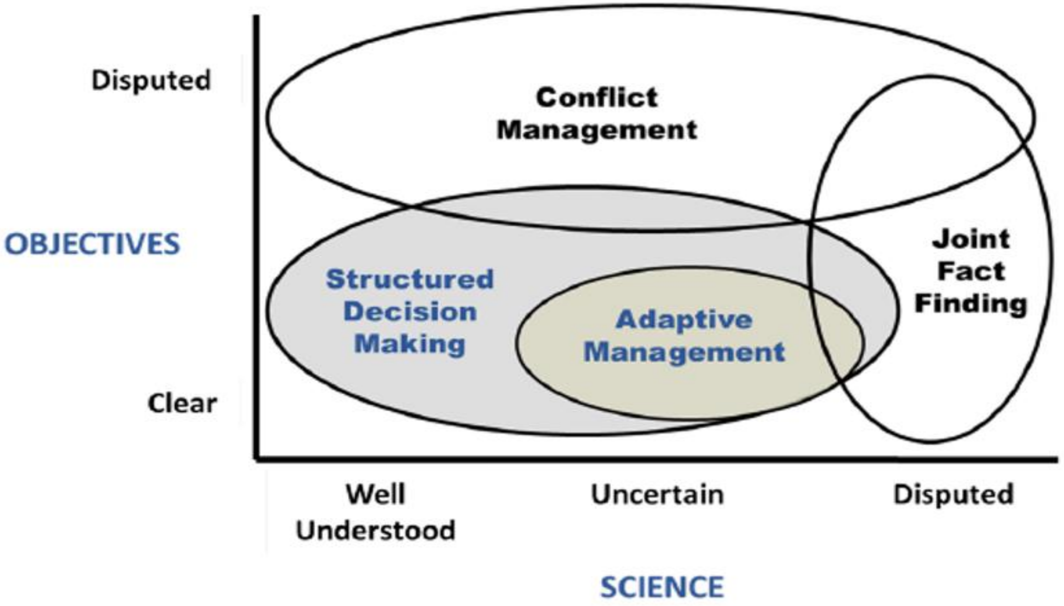
Developed by Michael C. Runge

When is SDM appropriate?

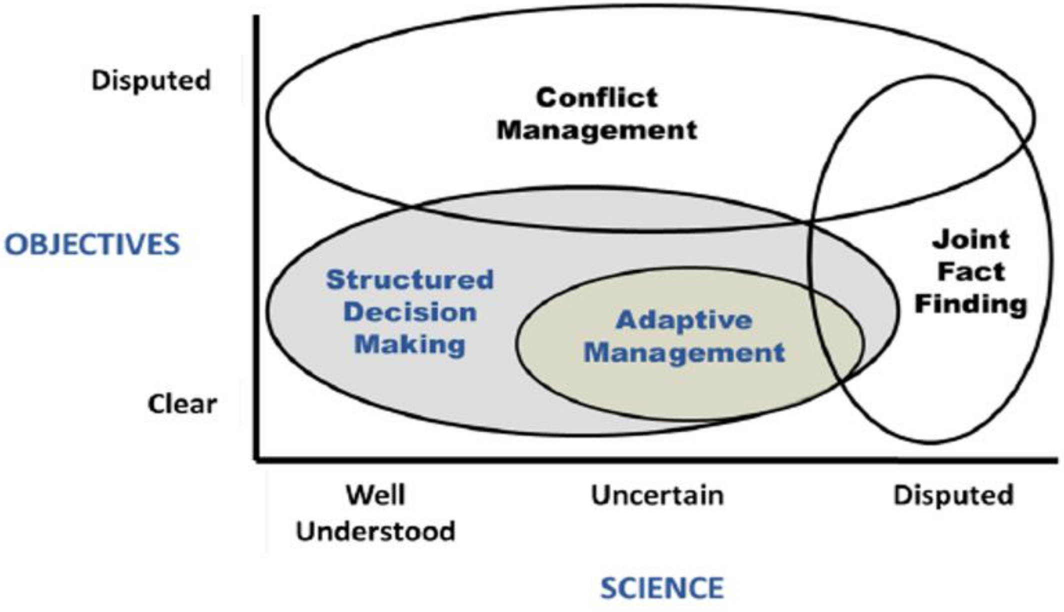
- For decisions involving a single decision-making body
  - But there can be multiple “stakeholders” or interest groups
- When there is a desire to have transparency and legacy in the decision-making process



(From Runge et al. 2013)

When is SDM **NOT** appropriate?

- When there are multiple, competing decision makers
- When institutional buy-in is impossible
- Should not be used to "prescribe" a decision
  - Rather SDM is used to aid/inform decision makers



(From Runge et al. 2013)

Developed by Michael C. Runge

SDM usefulness:

- SDM helps handle impediments including:
  - Hidden objectives
    - You don’t reveal what you want
  - Competing objectives
    - You have multiple things you care about
  - Complex alternatives
    - Your management actions are too confusing
  - Important uncertainties
    - There are biological, management, environmental uncertainties

SDM examples- natural resources

Waterfowl harvests
(Williams and Johnson 1995)

Whooping crane management
(Moore et al. 2008)

Bighorn Sheep disease mitigation
(Sells et al. 2016)

Bull trout reintroduction
(Brignon et al. 2017)

Dreissenid mussel management
(Sepulveda et al. 2022)

Prairie Pothole wetland management
(Hunt et al. 2020)

of Missouri

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SDM – who uses it?

Canadian Provincial Governments

US Federal Agencies

& USGS Cooperative Fish and Wildlife Research Faculty

US State Agencies

Consulting Firms

Other countries

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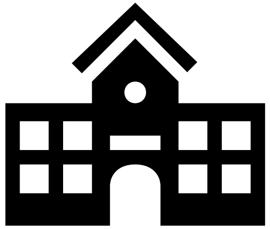
Developed by Brielle Thompson

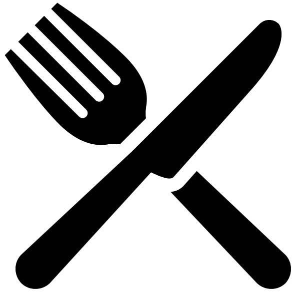
SDM examples- beyond natural resources

Buying
a car



Choosing a
college

Career
decisions



Deciding
dinner plans

Buying a
house

Making
travel plans

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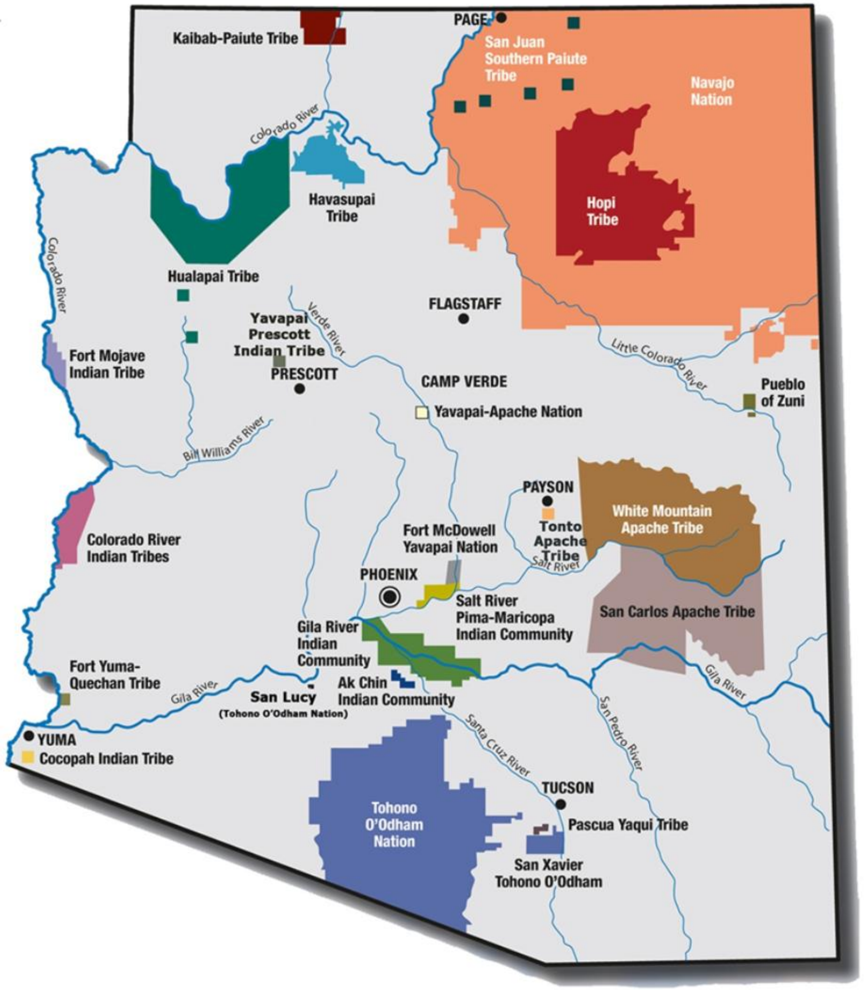
PrOACT Story –abridged

SDM project: Non-native fish control below glen canyon dam

(Runge et al. 2011)



Arizona Department of Education

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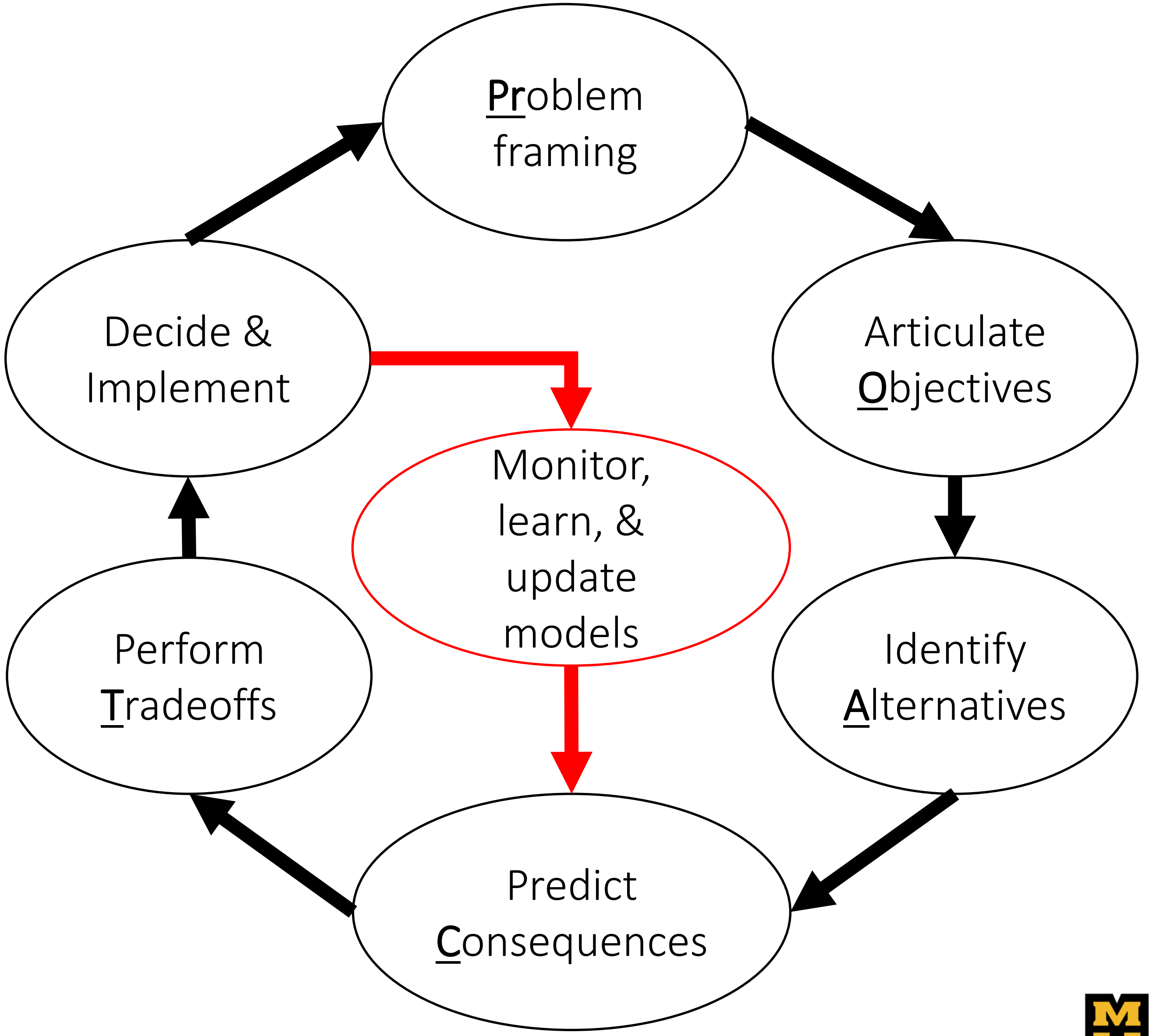
SDM project: Non-native fish control below glen canyon dam



Adapted, modified, and simplified from Runge et al. 2011

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SDM project: Non-native fish control below glen canyon dam

Problem framing statement:

Problem framing

Bureau of reclamation is trying to **make decisions regarding invasive trout management** to **achieve recovery of humpback chub** populations **over the next 5 years** in the **Little Colorado River, below the Glen Canyon** Dam considering **sacred sites and spiritual values of local Native American tribes (e.g., avoid taking of life), humpback chub recovery, trout invasion, recreational values, cost, and local economies.**

Adapted, modified, and simplified from Runge et al. 2011

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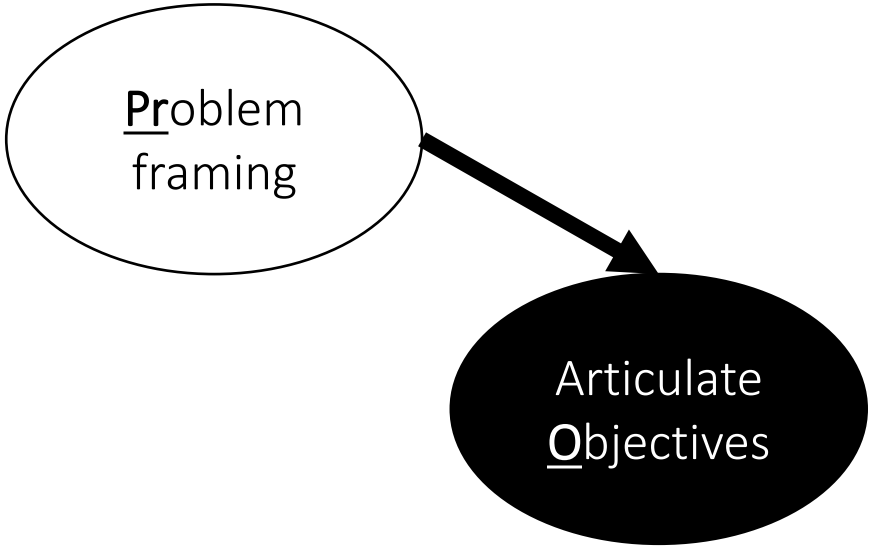
SDM project: Non-native fish control below glen canyon dam

Objectives:



Fundamental objectives

Maximize resources to protect tribal sacred sites and spiritual values

Maximize native species integrity

Maximize recreation

Minimize cost

Adapted, modified, and simplified from Runge et al. 2011

SDM project: Non-native fish control below glen canyon dam

Objectives (objectives hierarchy)

Fundamental objectives

- Maximize resources to protect tribal sacred sites and spiritual values
  - Min. taking of life
- Maximize native species integrity
  - Max. HBC population
  - Min. trout population
- Maximize recreation
  - Min. wilderness days lost
  - Max. fish catch
- Minimize cost
  - Min. trout removal cost
  - Max. dam power production

Means objectives

Process objectives

- Be respectful of tribal values and rituals

Strategic objectives

-Operate within the authority, capabilities, and legal responsibility of the Bureau of Reclamation

- Follow ESA compliances

Adapted, modified, and simplified from Runge et al. 2011

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SDM project: Non-native fish control below glen canyon dam

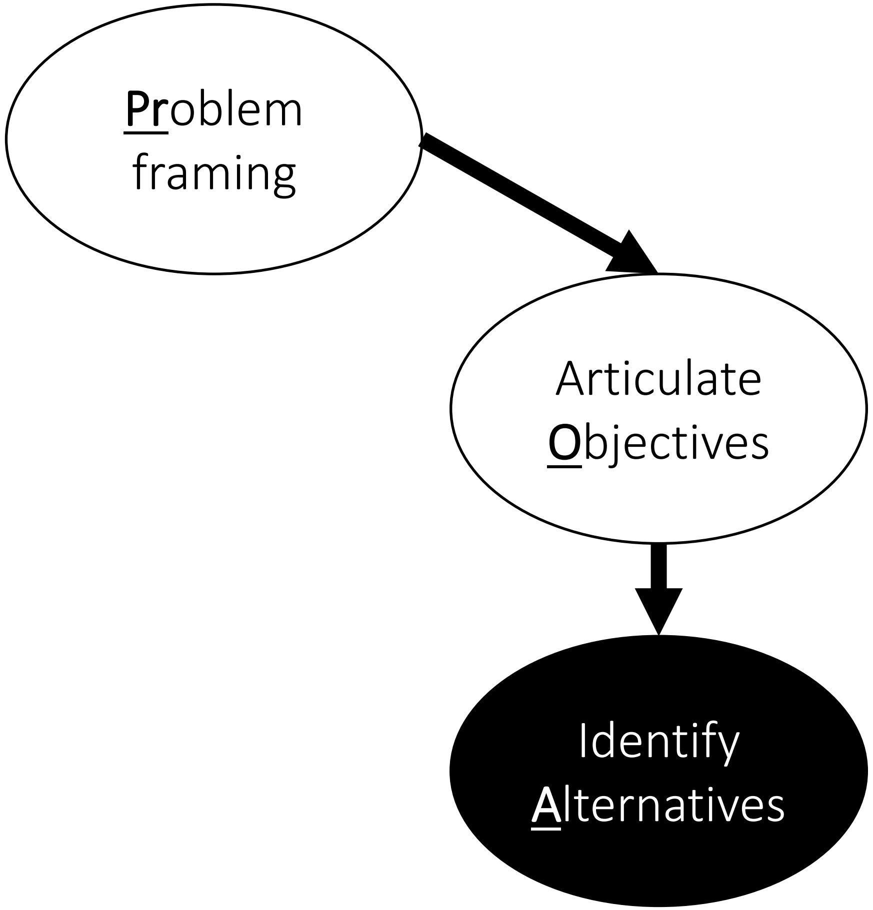
Alternatives:

THEMES:

a) Trout management
1. None
2. 25 fish/acre killed
3. 50 fish/acre killed
4. 25 fish/acre removed via helicopter
5. 50 fish/acre removed via helicopter

b) HBC habitat
1. None
2. Plant native vegetation
3. Build sediment curtain

c) Recreation
1. No changes
2. Remove 50 boating days per year
3. Close wilderness areas for 1 year
4. Prohibit boating for 1 year



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Adapted, modified, and simplified from Runge et al. 2011

SDM project: Non-native fish control below glen canyon dam

Alternatives:

---------------------THEMES---------------------

a) Trout management	b) HBC habitat	c) Recreation
1. None	1. None	1. No changes
2. 25 fish/acre killed	2. Plant native vegetation	2. Remove 50 boating days per year
3. 50 fish/acre killed	3. Build sediment curtain	3. Close wilderness areas for 1 year
4. 25 fish/acre removed via helicopter		4. Prohibit boating for 1 year
5. 50 fish/acre removed via helicopter		

Strategy table:

Strategy	A) Trout management	B) HBC habitat	C) Recreation
A (none)	a1	b1	c1
B	a2	b2, b3	c2
C	a3	b2, b3	c3
D	a4	b2, b3	c4
E	a5	b2	c3, c4

Adapted, modified, and simplified from Runge et al. 2011

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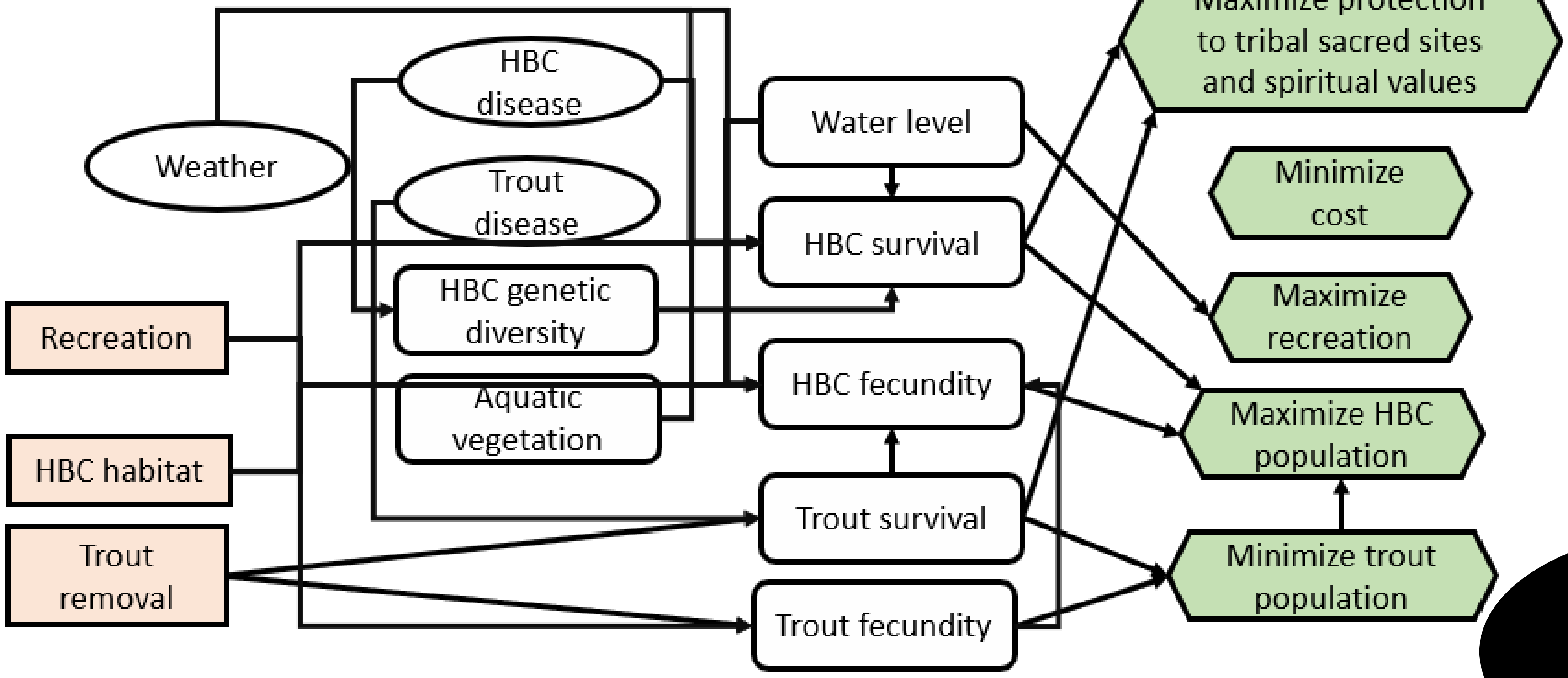
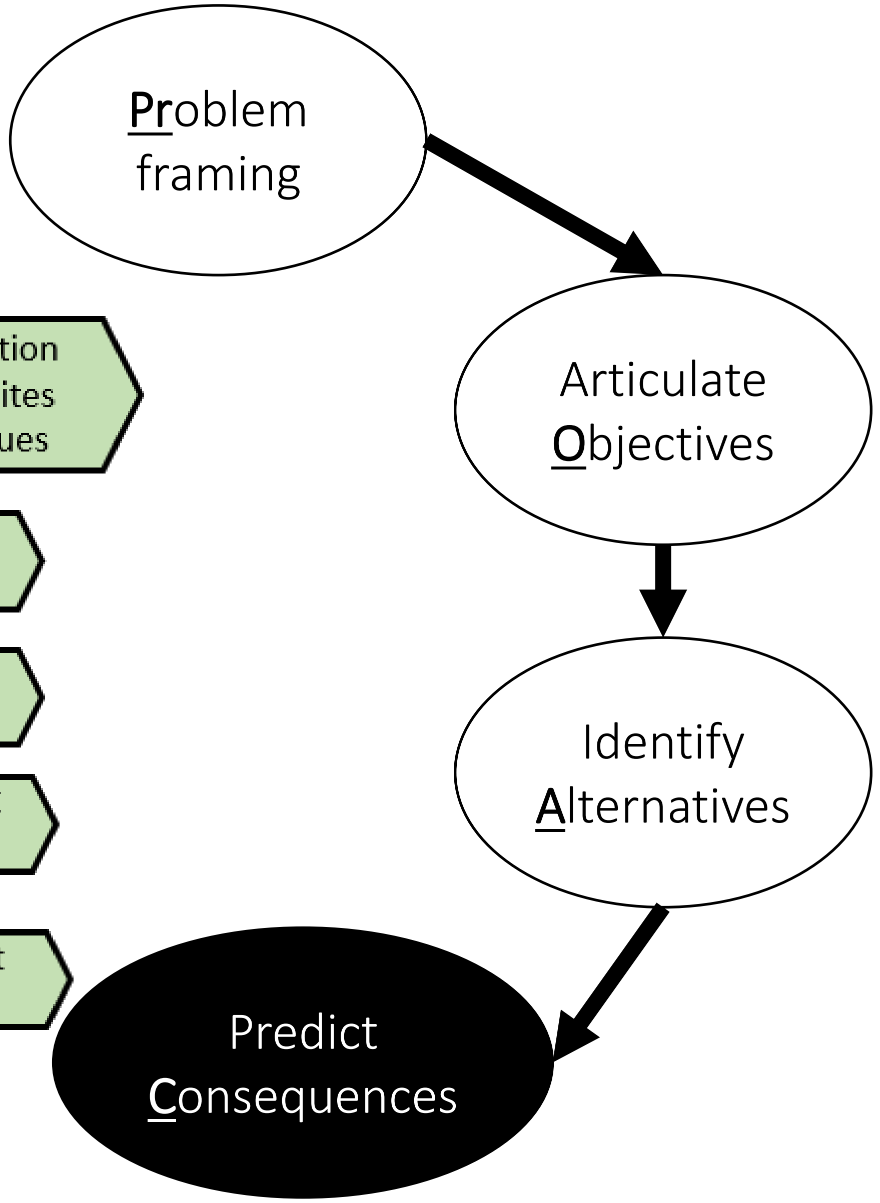
SDM project: Non-native fish control below glen canyon dam

Consequences:

Influence Diagram





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Adapted, modified, and simplified from Runge et al. 2011

SDM project: Non-native fish control below glen canyon dam

Consequences:

Simplified consequence table (relative table for illustration)

MODEL:	Objective			Alternative				
	Objective	Direction	Attribute	A	B	C	D	E
Expert elicitation	**Respect Life**	Max	[0-10 scale]	**6**	**7**	**6**	**9.5**	**9**
Population model	**HBC Recovery**	Max	[P(N>6000)]	**0.2**	**0.3**	**0.3**	**0.3**	**0.25**
Expert elicitation/ population model	**Wilderness Disturbance**	Min	[User-days]	**0**	**30**	**40**	**50**	**60**
	Cost	Min	[M$/5-yr]	**0**	**2.5**	**3**	**4.5**	**2**

Adapted, modified, and simplified from Runge et al. 2011

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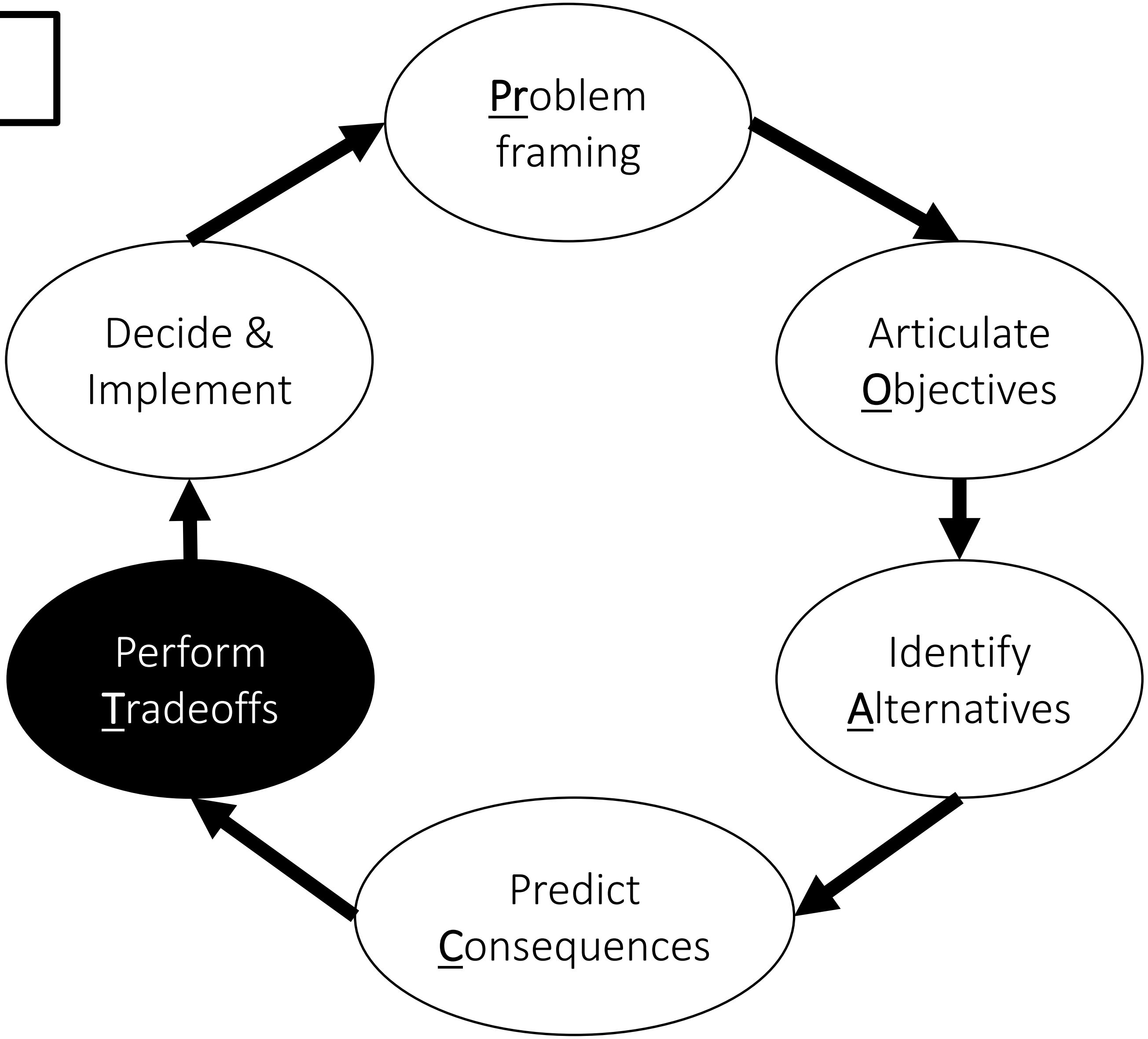
SDM project: Non-native fish control below glen canyon dam

Tradeoffs:

"How much you would give up on one objective in order to achieve gains on another objective"
- Gregory et al. 2012

Objective		
Objective	Direction	Attribute
Respect Life	Max	[0-10 scale]
HBC Recovery	Max	[P(N>6000)]
Wilderness Disturbance	Min	[User-days]
Cost	Min	[M$/5-yr]



Adapted, modified, and simplified from Runge et al. 2011

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SDM project: Non-native fish control below glen canyon dam

Tradeoffs:

"How much you would give up on one objective in order to achieve gains on another objective"
- Gregory et al. 2012

Objective Weights:

Hypothetical for illustration

0.2

0.4

0.1

0.3

Objective		
Objective	Direction	Attribute
Respect Life	Max	[0-10 scale]
HBC Recovery	Max	[P(N>6000)]
Wilderness Disturbance	Min	[User-days]
Cost	Min	[M$/5-yr]

Adapted, modified, and simplified from Runge et al. 2011

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SDM project: Non-native fish control below glen canyon dam

Tradeoffs:

Simplified consequence table (relative table for illustration)

Weights:

Hypothetical for illustration

Weights	Objective			Alternative				
	Objective	Direction	Attribute	A	B	C	D	E
0.2	**Respect Life**	Max	[0-10 scale]	6	7	6	9.5	9
0.4	**HBC Recovery**	Max	[P(N>6000)]	0.2	0.3	0.3	0.3	0.25
0.1	**Wilderness Disturbance**	Min	[User-days]	0	30	40	50	60
0.3	**Cost**	Min	[M$/5-yr]	0	2.5	3	4.5	2

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Adapted, modified, and simplified from Runge et al. 2011

SDM project: Non-native fish control below glen canyon dam

Tradeoffs:

Simplified consequence table (relative table for illustration)

Weights:

Hypothetical for illustration

Weights	Objective			Alternative				
	Objective	Direction	Attribute	A	B	C	D	E
0.2	**Respect Life**	Max	[0-10 scale]	**6**	**7**	6	9.5	**9**
0.4	**HBC Recovery**	Max	[P(N>6000)]	**0.2**	0.3	0.3	0.3	**0.25**
0.1	**Wilderness Disturbance**	Min	[User-days]	**0**	30	40	50	**60**
0.3	**Cost**	Min	[M$/5-yr]	**0**	2.5	3	4.5	**2**

Rescale!

0 to 1

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Adapted, modified, and simplified from Runge et al. 2011

SDM project: Non-native fish control below glen canyon dam

Tradeoffs:

Simplified consequence table (relative table for illustration)

Weights:

Hypothetical for illustration

Weights	Objective	Direction	Attribute	A	B	C	D	E
	Objective			**Alternative**				
	Objective	Direction	Attribute	A	B	C	D	E
0.2	**Respect Life**	Max	[0-10 scale]	**0**	**0.29**	**0**	**0.86**	**1**
0.4	**HBC Recovery**	Max	[P(N>6000)]	**0**	**1**	**1**	**1**	**0.5**
0.1	**Wilderness Disturbance**	Min	[User-days]	**1**	**0.5**	**0.33**	**0.17**	**0**
0.3	**Cost**	Min	[M$/5-yr]	**1**	**0.44**	**0.33**	**0**	**0.56**

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SDM project: Non-native fish control below glen canyon dam

Tradeoffs:

Simplified consequence table (relative table for illustration)

Weights:

Hypothetical for illustration

Weights	Objective	Direction	Attribute	A	B	C	D	E
0.2	**Respect Life**	Max	[0-10 scale]	**0**	**0.29**	**0**	**0.86**	**1**
0.4	**HBC Recovery**	Max	[P(N>6000)]	**0**	**1**	**1**	**1**	**0.5**
0.1	**Wilderness Disturbance**	Min	[User-days]	**1**	**0.5**	**0.33**	**0.17**	**0**
0.3	**Cost**	Min	[M$/5-yr]	**1**	**0.44**	**0.33**	**0**	**0.56**
	Weighted outcome: (sum product of weight and outcome)			**0.4**	**0.64**	**0.53**	**0.59**	**0.57**

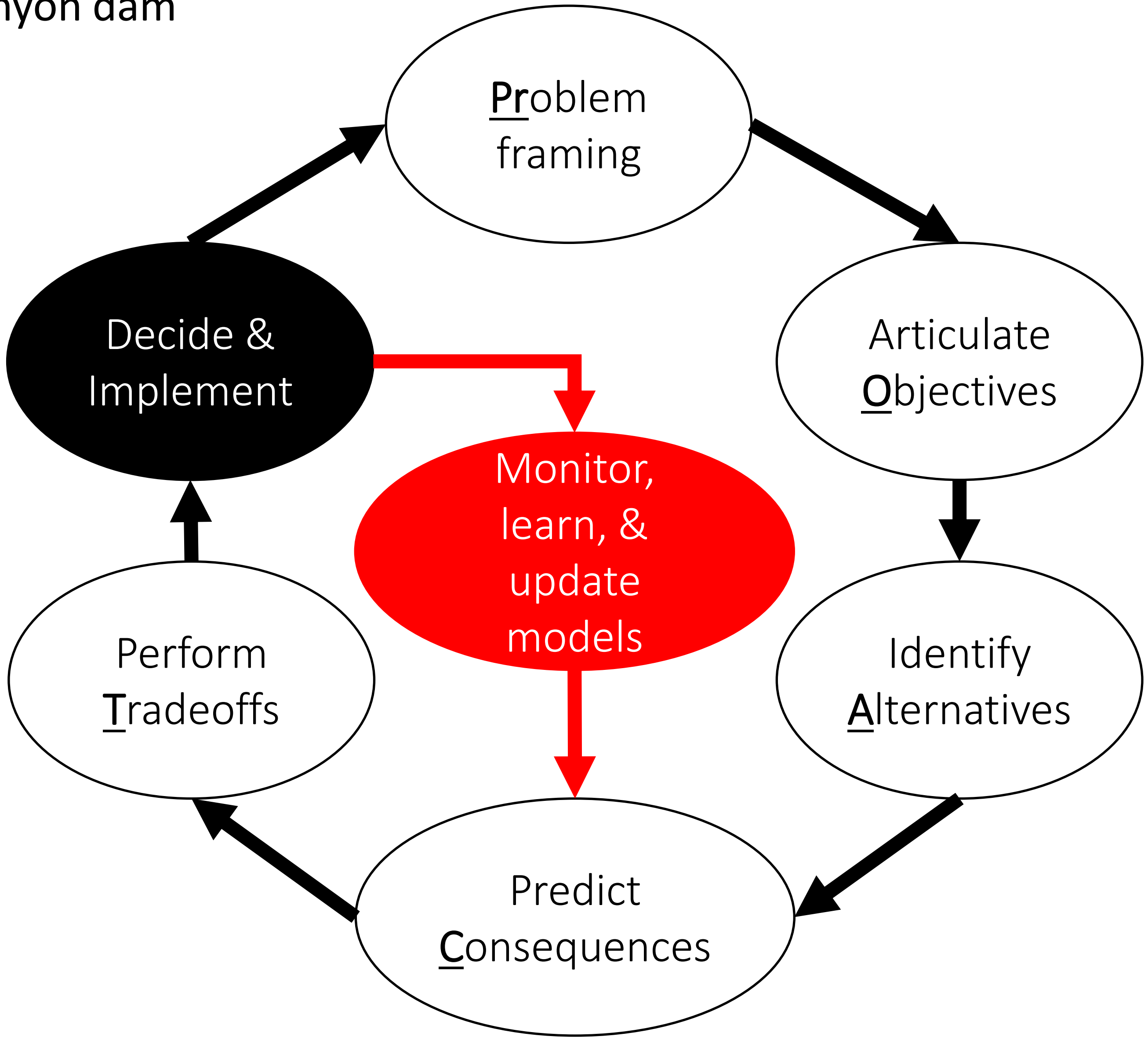
Adapted, modified, and simplified from Runge et al. 2011

SDM project: Non-native fish control below glen canyon dam

Decision/ adaptive management approach:

"A value of information analysis pointed to an adaptive strategy that contemplates three possible long-term management actions"

- No action
- Lower Colorado River Removal
- Paria to Badger Reach Removal



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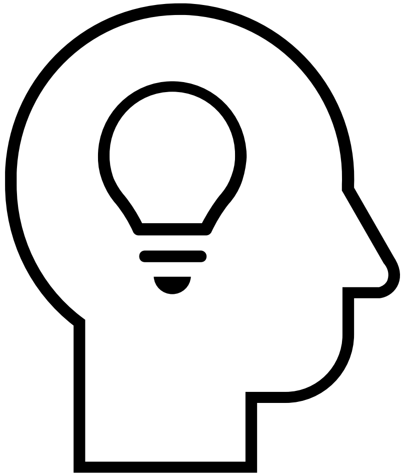
Adapted, modified, and simplified from Runge et al. 2011

Skills check (15 minutes)

- Divide into 4-5 groups
- I will hand out a scenario examples to each group

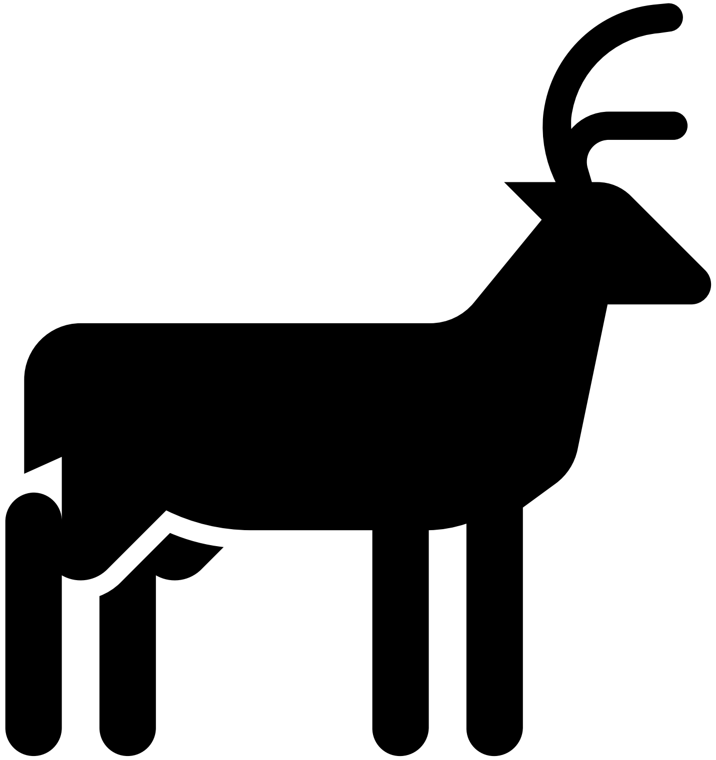
- Each group will identify:
  - The bias(es) present
  - How the bias could affect decision outcomes
  - How SDM principles (e.g., PrOACT, problem decomposition) could improve the decision

- 1 minute presentation to the class



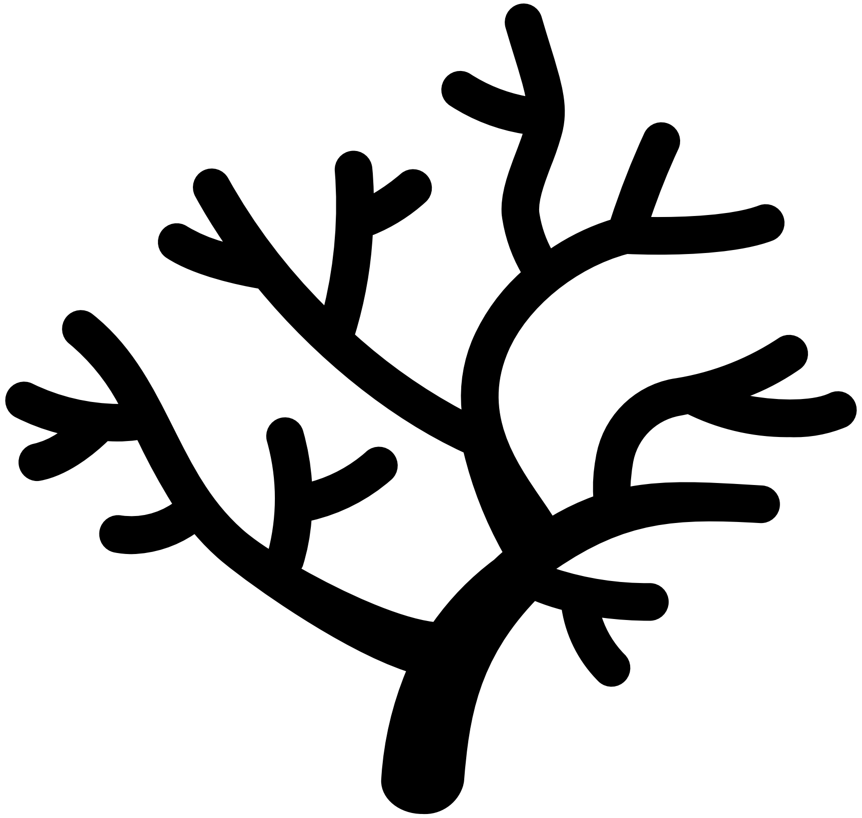
Group 1:

A wildlife agency has spent $2 million developing a corridor to connect fragmented habitats. Early monitoring shows minimal animal movement through the corridor. Despite this, the agency continues investing in signage, fencing, and outreach.



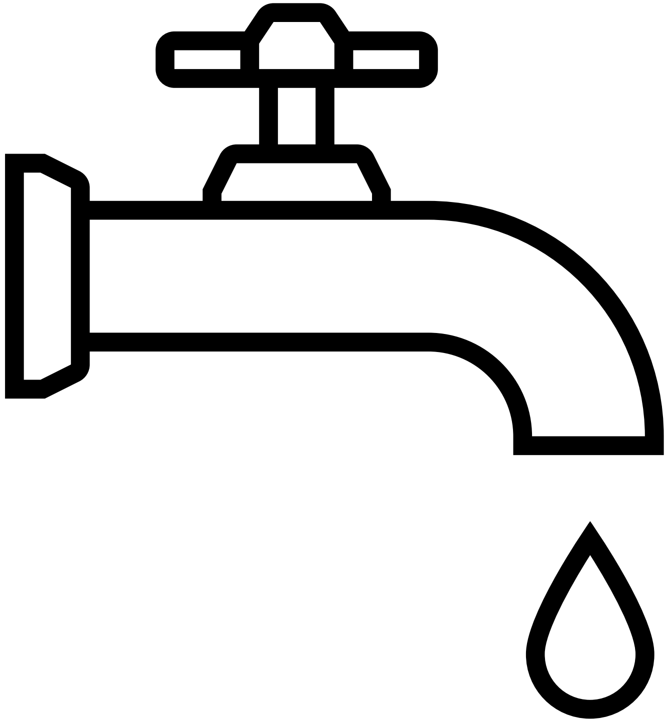
Group 2:

After watching a documentary on coral bleaching, a coastal conservation group shifts all funding to reef restoration, even though local data shows mangrove degradation is a more pressing issue.



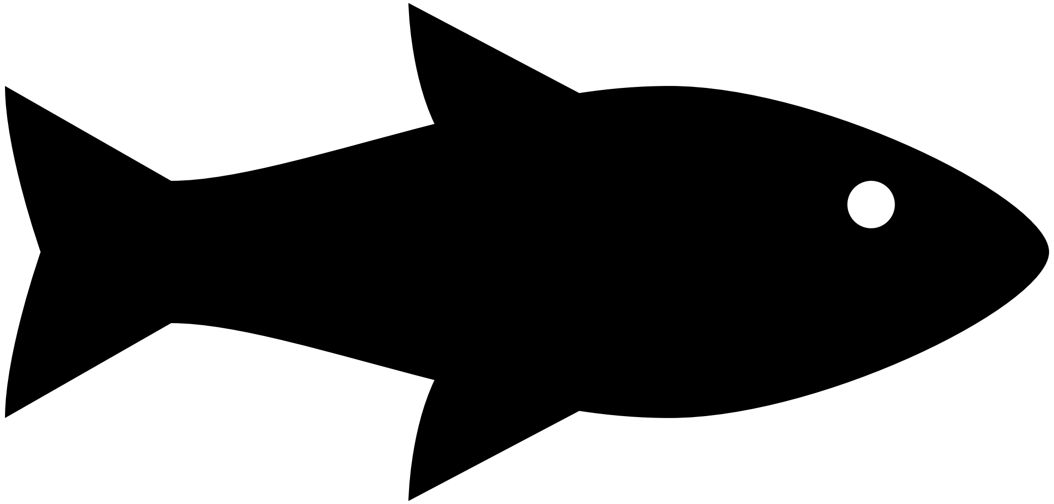
Group 3:

A regional water authority is considering expanding a reservoir to increase water storage capacity. The expansion was proposed 10 years ago, and millions have already been spent on feasibility studies and land acquisition. However, recent climate models suggest that rainfall patterns are shifting, and the reservoir may not fill as expected. Despite this, the authority continues to push forward with the expansion.



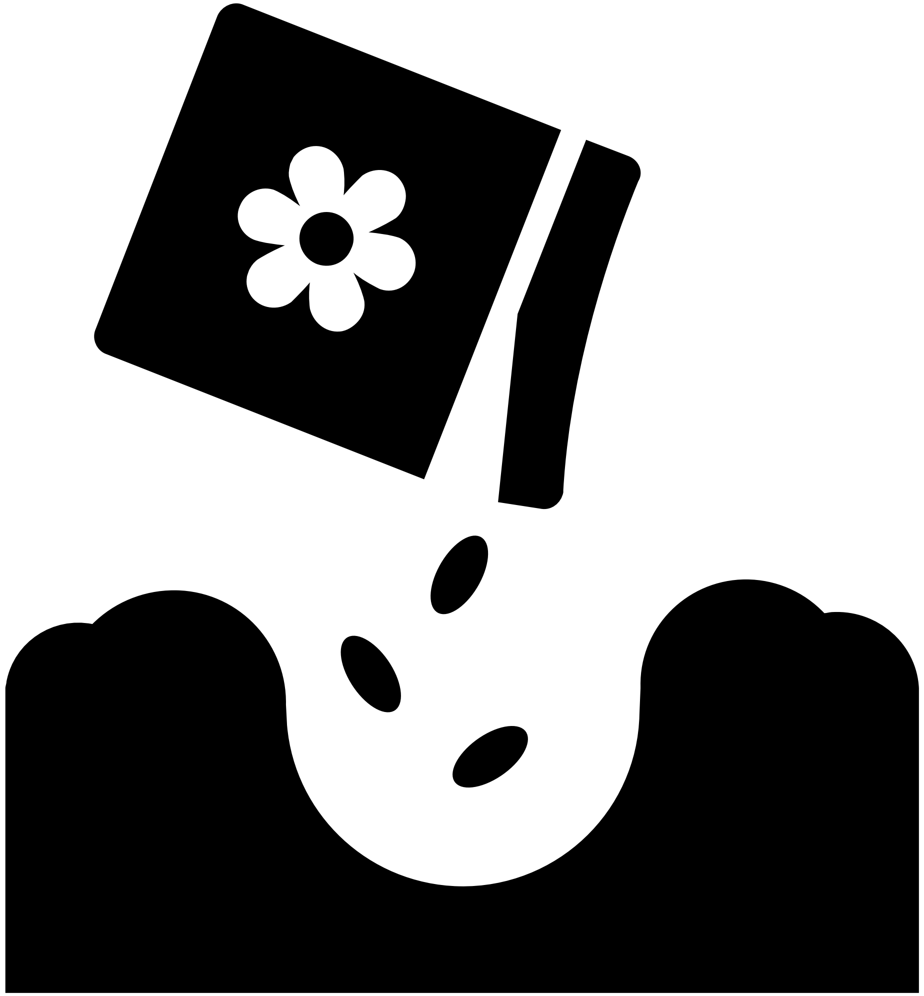
Group 4:

A state agency has been monitoring a native minnow species for over a decade using a fixed set of sampling sites and methods. Recent studies suggest that the species has shifted its range due to changing stream temperatures and flow patterns. However, the agency continues using the same monitoring protocol, arguing that consistency is key for long-term data.



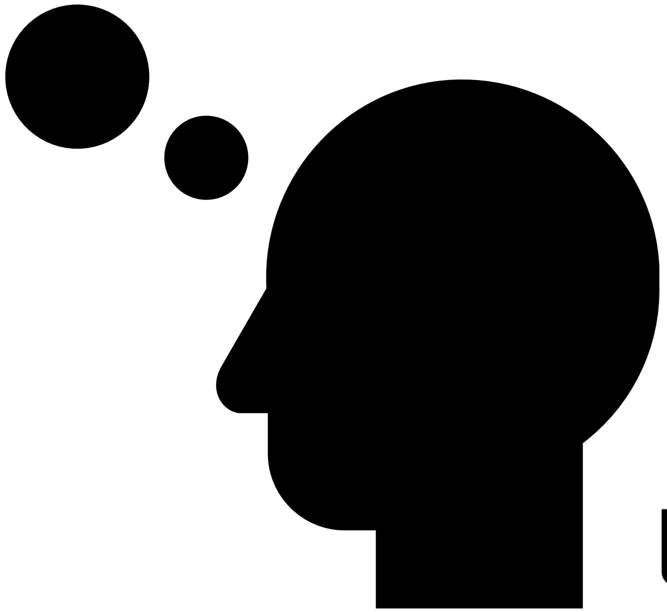
Group 5:

A conservation district has used the same fertilizer blend for over 15 years to support native grass restoration on degraded soils. Recent soil tests show increased salinity and reduced microbial activity, suggesting the blend may be contributing to long-term soil degradation. Despite this, the district continues using the same formula, citing past success and ease of procurement.



Discussion:

What makes a good decision?



Looking ahead:

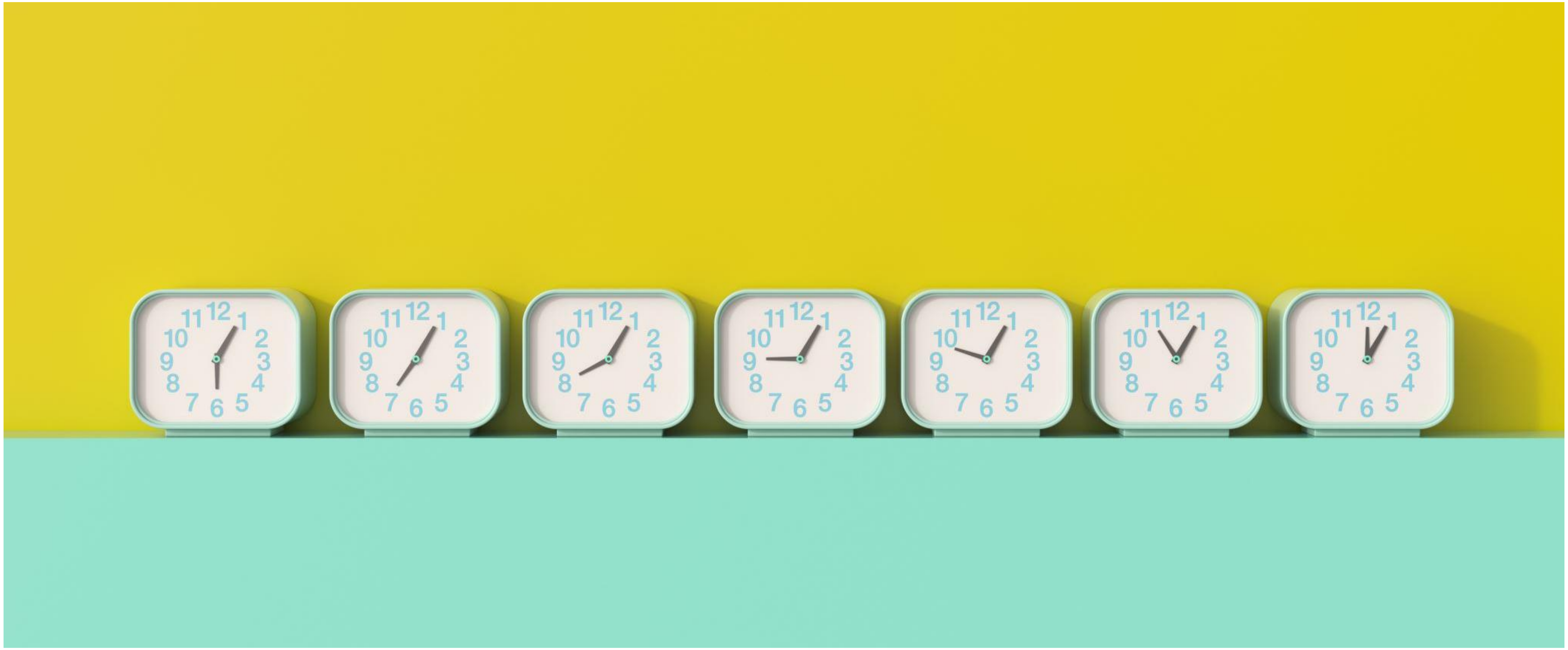
Next week: Pr step of PrOACT

Weekly: Work through a step of the PrOACT process/ learn extra tools

Last week of class: Elevator pitch of your research project in terms of SDM/PrOACT

Note: Abridged PrOACT story slides with a star on the upper right are good examples to use for your presentation

Extra time activities:



Good decision making -Activity

- Think about the last time you made a big decision, or a future decision you are worried about (personal or research)
  - What was the decision?
  - What were the desired outcomes of your decision?
    - What did you care about? What did you want out of the decision?
  - Did you have any alternatives you were considering?
  - How did you make your decision?
  - What made the decision challenging?

Good decision making –Activity 2

- Individually write down qualities that you think make a good decision
- Then, in groups compare your lists
- Then, we will come together to discuss what makes a good decision

System 1 vs System 2- Activity

- Write your immediate reaction to the following scenarios:
  - A lake is suddenly overrun with invasive snails
  - A farming region experiences a severe drought
  - A wetland manager notices a sudden die-off of native frogs
  - After a nearby wildfire, a community demands immediate action
  - A forest reserve reports a sharp decline in its native owl population over the past two years

- With a partner discuss how your system 2 brain might respond to the scenarios

Reading discussion:

Discuss Gregory and Long 2012 Chapter 1:

1. What distinguishes Structured Decision Making (SDM) from traditional environmental decision-making approaches such as science-based, consensus-based, or economic analysis?
2. In what ways can SDM help build trust and collaboration among stakeholders with conflicting interests?
3. The chapter emphasizes the importance of developing creative alternatives. Why is this step often overlooked in conventional decision-making, and how does SDM encourage innovation?
4. What are some potential limitations or challenges of implementing SDM in real-world environmental management scenarios?
5. The authors describe SDM as both a science and an art. What does this mean?