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Week 4:

Alternatives & Consequences
Steps of PrOACT

Instructor: Brielle K Thompson

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

Review of last week

- Discussed the Objectives step of SDM
- Process for identifying objectives
  1. Articulate goals & concerns
  2. Convert goals & concerns to objectives
  3. Structure objectives
     3a. Classify and distinguish types of objectives
     3b. Create an objectives hierarchy
  4. Create measurable attributes for each objective

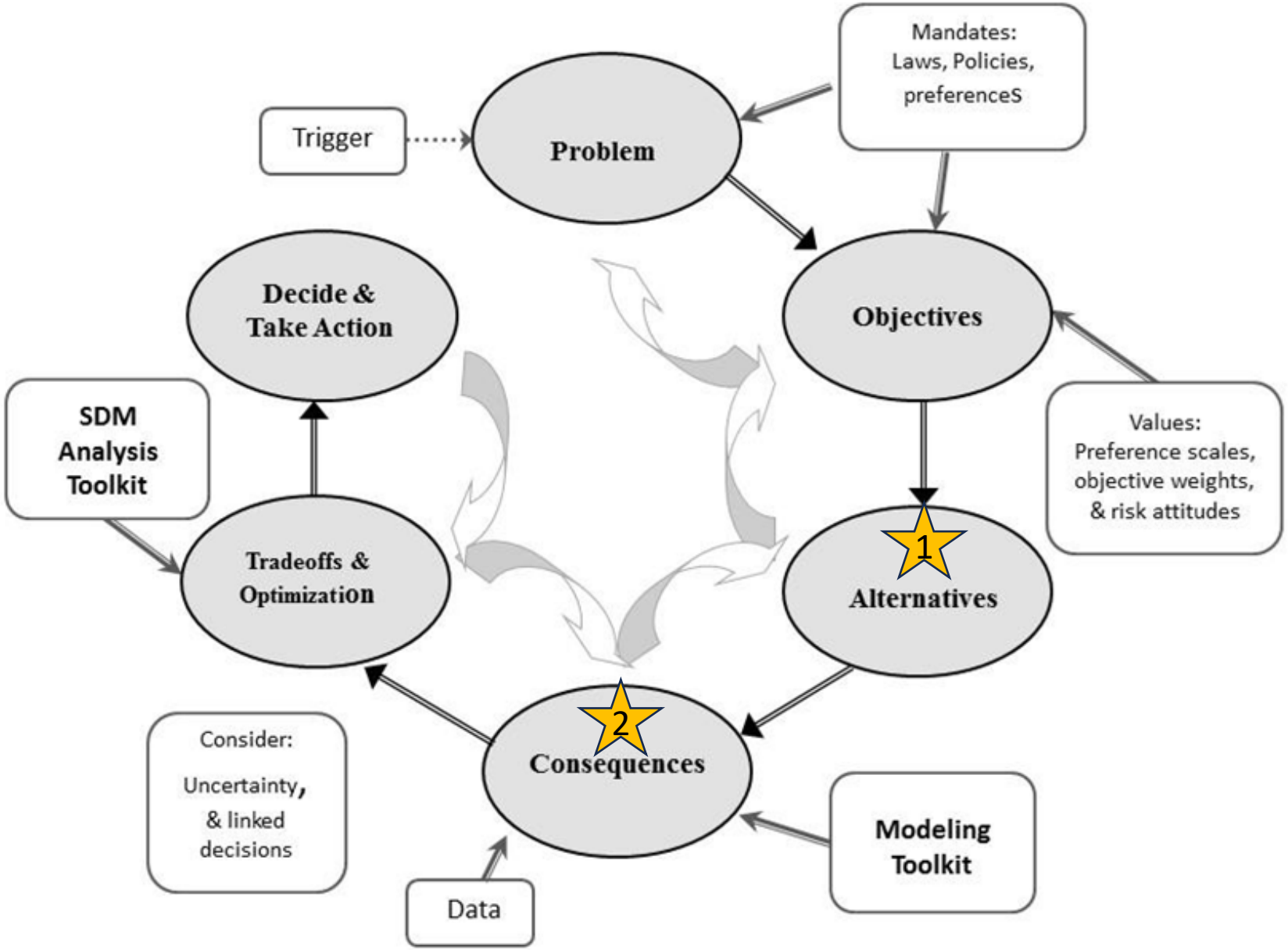
  Repeat as needed
- Pieces of an objective:

  Direction + what is desired + attribute

  (Maximize/ Minimize)

  (Natural/ constructed/ proxy scale units)

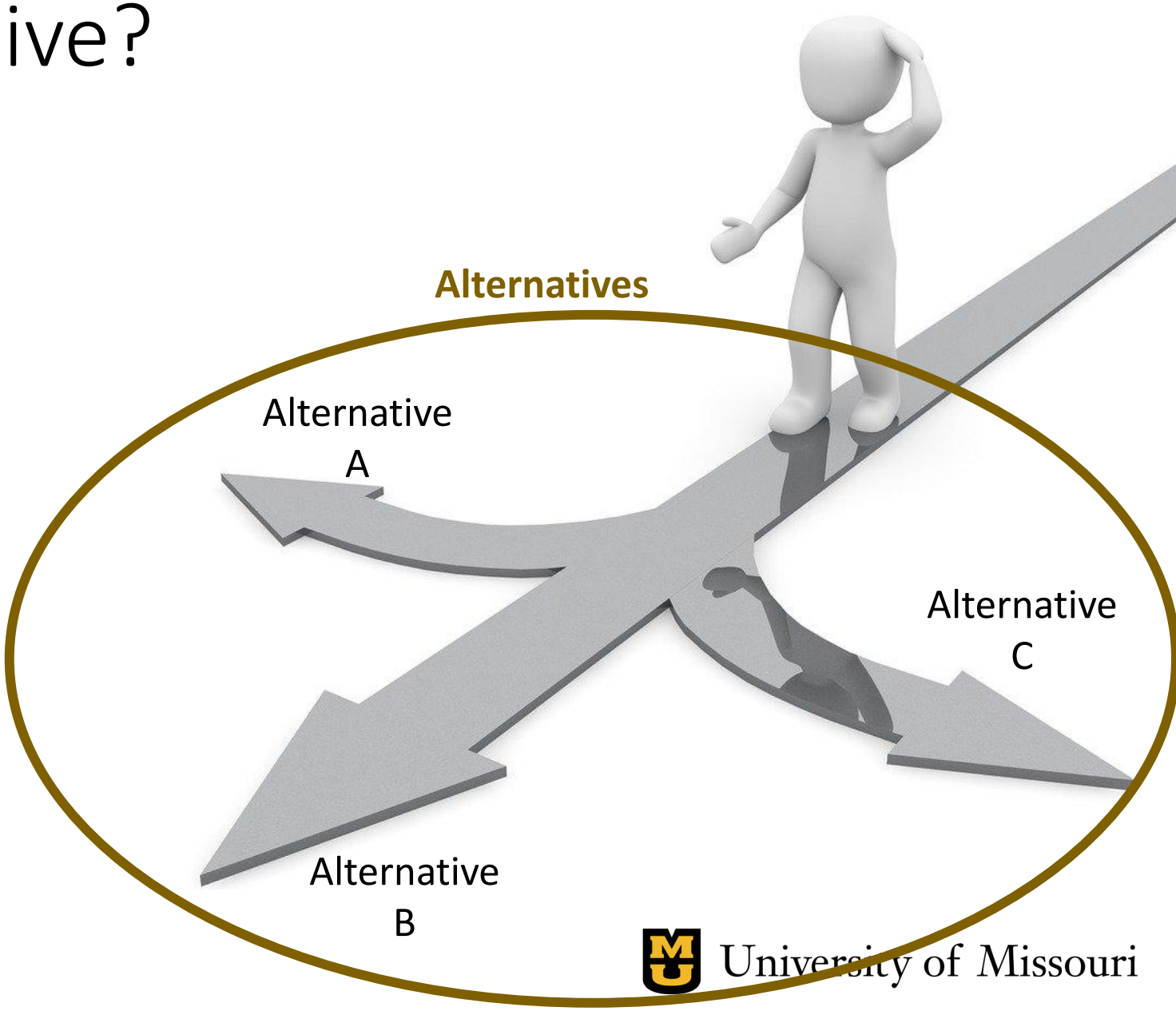
Today:
Learn about the Alternatives & Consequences step



Source: Jean Fitts Cochrane

What is an alternative?

- Alternative (singular)
  - A potential solution to a decision problem
- Alternatives (plural)
  - The set of potential solutions to a decision problem



Importance of good alternatives

- "The action selected will only be as good as the best alternative that is considered"
- A good alternative is one that provides a good chance of achieving objectives
- Good alternatives are:
  - Values-focused
  - Fully specified
  - Internally coherent
  - Distinct

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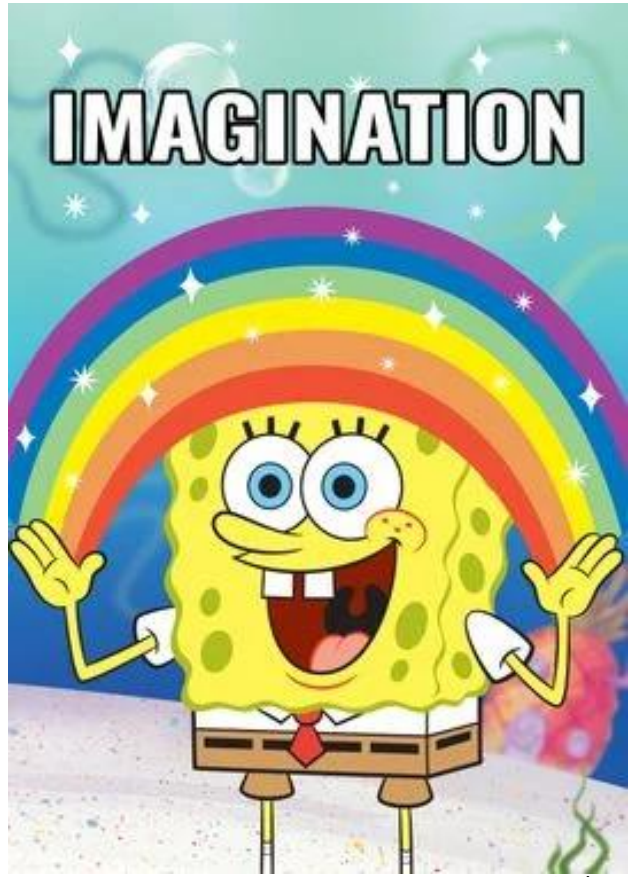
Good alternatives require

- **Imagination**
  - Beware of the tendency to limit our ideas to what are thought to be ‘practical’ alternatives
- **Creativity**
  - Think of the widest range of possible alternatives
  - Don’t let preconceived ideas or constraints be limiting

To promote creativity – conduct a game:

Make group list 10 things they can do with [X = a pizza box, shoelace, etc.] and reward the most creative solution



Displate

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Challenges to identifying alternatives

- Falling prey to cognitive biases (e.g., status quo bias)
- Accepting real or perceived constraints
- Evaluating alternatives prematurely

Activity – Don’t stick to the status quo!

Think of a new creative alternative that is different from the status quo

Status quo:	**Think of a new alternative:**
A wetland restoration project currently excludes public access to protect sensitive species	
A park currently allows recreational fishing year-round with no catch limits.	
The forest is managed primarily for timber production and clearcutting used as the standard harvesting method every 30 years	

Developed by Brielle Thompson

Suggestions to identify alternatives

1. Focus on fundamental objectives and address conflicting objectives

- Create alternatives to achieve the best possible consequences for each fundamental objective, one at a time.

- Then, create hybrid alternatives to satisfy more than one objective. Include conflicting objectives.

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Suggestions to identify alternatives

1. Focus on fundamental objectives and address conflicting objectives

Example: Rare Snakes

- Problem/concern:
  - Many rare snakes are killed during capture
- Objectives:
  - Minimize capture mortality
  - Maximize pet industry
- Alternatives:
  - Status quo – do nothing
  - Ban sale of snakes
  - Others?

Potentially conflicting!!

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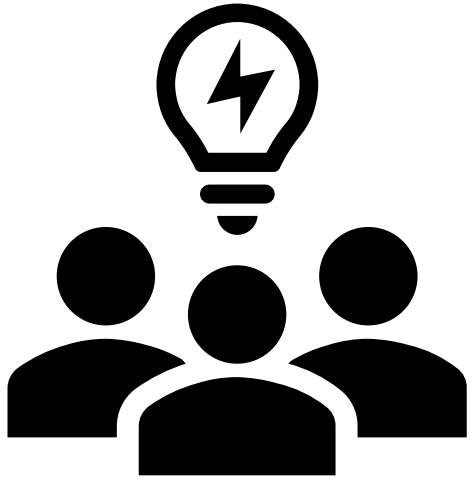
Suggestions to identify alternatives
2. Challenge constraints

Tips:

- Distinguish real and perceived constraints
- Don’t anchor on initial set of options
- Don’t evaluate – just develop
- Give people time and permission to be creative



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Suggestions to identify alternatives

2. Challenge constraints

Activity – create alternatives despite constraints

Example: Bird translocation

Which of several islands should an endangered bird be translocated?

- **Perceived constraint:** Introduced predators on Island A make it unsuitable

- In groups: come up with 3 creative alternatives?

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Suggestions to identify alternatives

3. Create groups of alternatives

- Groups of alternatives includes portfolios and strategies

JARGON ALLERT!!

- **Alternatives** = general term for complete, comparable solutions to a decision problem
- **Actions** = alternatives formed by individual options
- **Strategies and Portfolios** = alternatives formed by combinations of actions

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Suggestions to identify alternatives
3a. Creating portfolios

- Portfolio: a combination of **like** elements arranged in a set
- The elements themselves can be actions
  - e.g., set of research projects, funding allocation
- The combination now represents a single alternative
  - e.g., stock portfolio
- Constraints often limit number of possible portfolios
  - e.g., total budget for allocation across projects

Suggestions to identify alternatives

3a. Creating **portfolios**

Example: portfolios for invasive species removal

Portfolio Alternatives

Target species to remove	
A	Portfolio 1
B	Portfolio 2
C	Portfolio 3
D	Portfolio 4
Action 1 in Portfolio 5 + Action 2 in Portfolio 5 (A + B)	Portfolio 5
…	
B+C+D	Portfolio N-1
A+B+C+D	Portfolio N

Combination of like elements

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Suggestions to identify alternatives
3b. Creating **strategies**

- Strategy: alternative **c**ombining multiple **unlike** elements:
- Strategy table:
  1) Group actions into themes (columns)
  2) Create distinct strategies that represent different approaches or emphasize different objectives
  3) Select the actions in each theme that fit each strategy
  4) Combine selected elements into a strategy
  5) Repeat steps 2-4 to create all strategies

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3b. Creating **strategies**

- Strategy table: Chipotle menu

Themes of ingredients:	*Meat*	*Rice, Beans, and Veggies*	*Top It Off*
	None	Brown rice	None
	Steak	White rice	Salsa (Mild)
	Carnitas	Black beans	Salsa (Hot)
	Chicken	Pinto beans	Sour cream
	Barbacoa	Fajita veggies	Tomatillo
			Chili-Corn salsa
			Lettuce
			Guacamole
			Cheese

3b. Creating **strategies**

- Strategy table: Chipotle menu

Themes of ingredients:	*Meat*	*Rice, Beans, and Veggies*	*Top It Off*
Strategies (aka burritos): **"Brielle's favorite"**	None Steak Carnitas **Chicken** Barbacoa	**Brown rice** White rice **Black beans** Pinto beans **Fajita veggies**	None **Salsa (Mild)** Salsa (Hot) Sour cream Tomatillo Chili-Corn salsa **Lettuce** **Guacamole** **Cheese**

3b. Creating **strategies**

- Strategy table: Chipotle menu

Themes of ingredients:	*Meat*	*Rice, Beans, and Veggies*	*Top It Off*
Strategies (aka burritos): **"The Barnyard"**	None **Steak** **Carnitas** **Chicken** Barbacoa	Brown rice **White rice** Black beans **Pinto beans** Fajita veggies	None Salsa (Mild) **Salsa (Hot)** Sour cream Tomatillo Chili-Corn salsa Lettuce Guacamole Cheese

3b. Creating **strategies**

- Strategy table: Chipotle menu

Themes of ingredients:	*Meat*	*Rice, Beans, and Veggies*	*Top It Off*
Strategies (aka burritos): **"The Veggie"**	**None** Steak Carnitas Chicken Barbacoa	**Brown rice** White rice **Black beans** **Pinto beans** **Fajita veggies**	None **Salsa (Mild)** Salsa (Hot) **Sour cream** Tomatillo **Chili-Corn salsa** **Lettuce** **Guacamole** **Cheese**

3b. Creating **strategies**

- **Final strategy table**: Chipotle menu

Alternative Strategies

Themes→ ↓ Strategies	*Meat*	*Rice, Beans, and Veggies*	*Top It Off*
Brielle's Favorite	Chicken	Brown rice, Black beans, Veggies	Salsa (mild), Chili-corn, Lettuce, Guacamole, Cheese
The Barnyard	Steak, Carnitas, Chicken	White rice, Pinto beans	Salsa (hot), Cheese
The Veggie	None	Brown rice, Black beans, Pinto beans, Veggies	Salsa (mild), sour cream Chili-corn, Lettuce, Guacamole, Cheese

Meat action for the Barnyard strategy

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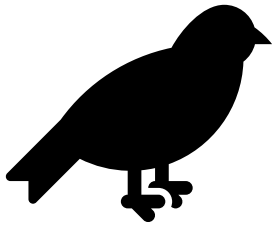
3b. Creating **strategies**



- Example: Threatened species recovery

Themes:	*Habitat Protection*	*Predator Control*	*Enhance Population*	*Alternative Economic Activity*
	Status Quo	Status Quo Harvest (5%)	None	None
	Ban logging in critical habitat	Increase harvest rate of predator to 10%	Maternity Pens	Promote sustainable harvest of species through lottery
	Develop linkage corridors	Increase harvest rate of predator to 50%	Captive Breeding Translocate	Promote non-consumptive recreation

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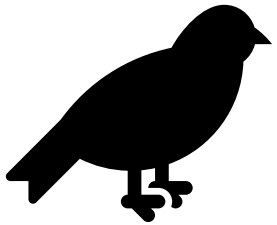
3b. Creating **strategies**



- **Final strategy table** for threatened species recovery,

Themes→ ↓ Strategies	*Habitat Protection*	*Predator Control*	*Enhance Population*	*Alternative Economic Activity*
Status Quo	Status Quo	Status Quo Harvest (5%)	None	None
"On the Go" (Dispersal)	Develop linkage corridors	Increase harvest rate of BNEG to 10%	Translocate	Promote non-consumptive recreation
Increase Pop to Carrying Cap	Ban logging in critical habitat	Increase harvest rate of BNEG to 50%	Captive Breeding	Promote non-consumptive recreation

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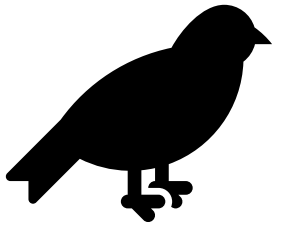
Activity – create more strategies

Task: create 3 new strategies based on the following table

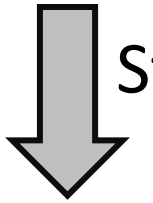


- Example: Threatened species recovery

Themes:	*Habitat Protection*	*Predator Control*	*Enhance Population*	*Alternative Economic Activity*
	Status Quo	Status Quo Harvest (5%)	None	None
	Ban logging in critical habitat	Increase harvest rate of predator to 10%	Maternity Pens	Promote sustainable harvest of species through lottery
	Develop linkage corridors	Increase harvest rate of predator to 50%	Captive Breeding Translocate	Promote non-consumptive recreation

----------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

Example: Humpback Chub (HBC) recovery in invasive trout waters (Runge et al. 2011)

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

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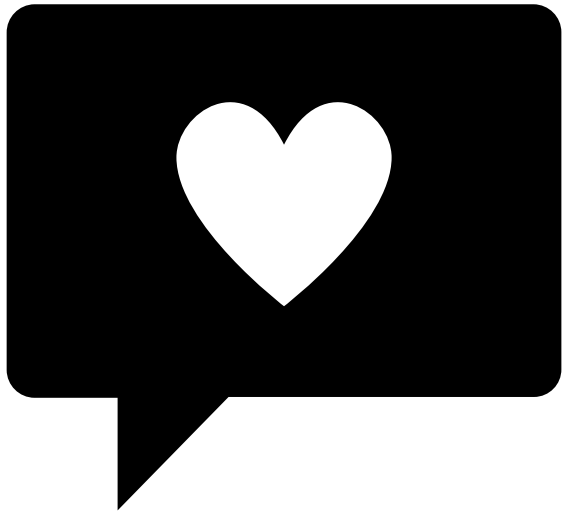
4. Revisit objectives



- Once you generate initial set of alternatives:
  - Be sure you've properly separated fundamental from means objectives
  - Identify if additional objectives exist

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General tips:

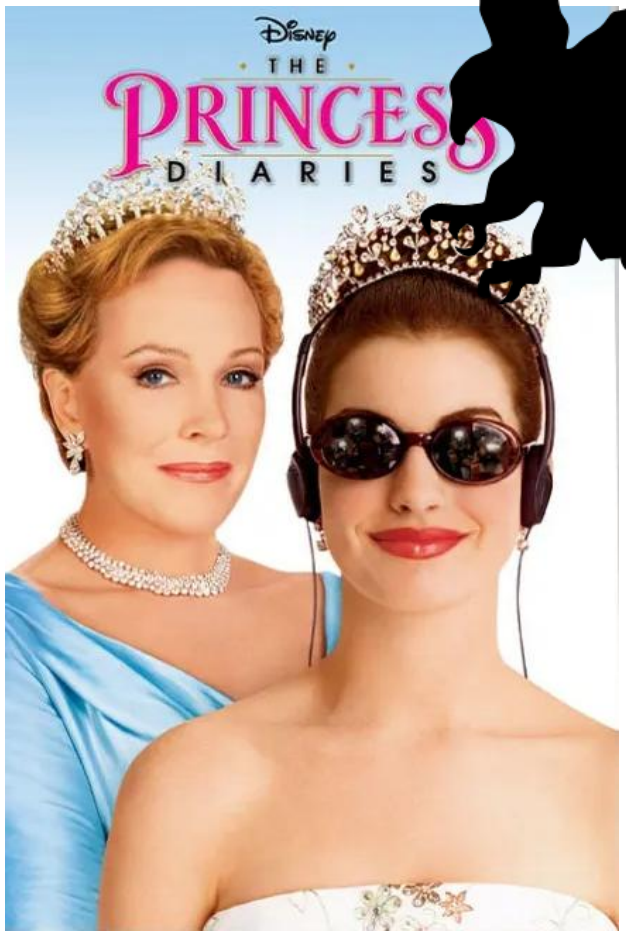
- SDM is iterative, don’t stop looking for alternatives
- Create first, evaluate later
- Consider alternatives that …
  - Are an ongoing process
  - Gather more information
- Treat ‘unique’ alternatives as real and subject to the same evaluation as other alternatives

Skills Check Task 1 – Create Alternatives

Eagle reintroduction in Genovia

Consider this decision…

- **Decision maker**: Refuge manager who is also interested in stakeholder's perspectives & appeasing the royal crown
- **Trigger**: Eagle population is nearly extinct in Genovia
- **Actions**: Reintroduction, captive breeding, habitat management, etc
- **Constraints**: Budget
- **Consideration**: Nearby sport anglers (whose license sales fund conservation) like to fish on eagle prey
- **Frequency and Timing**: One time decision
- **Scope**: In two potential refuges in the kingdom (Refuge A or B)
- **Problem class**: Multiple objective with uncertainty



Fundamental objectives:

- Maximize eagle persistence
- Minimize cost
- Maximize angler satisfaction

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Skills Check Task 1 – Create Alternatives

Task 1: Create Alternatives *(use tables below as inspiration)*

Add more!

Themes:	*Reintroduction*			
	Status Quo (No reintroduction)			
	Reintroduce 20 birds in Refuge A			
	Reintroduce 20 birds in Refuge B			
	Reintroduce 10 in Refuge A & 10 in B			

Add these!

Create 4 strategies

Themes→ ↓ Strategies	Reintroduction			

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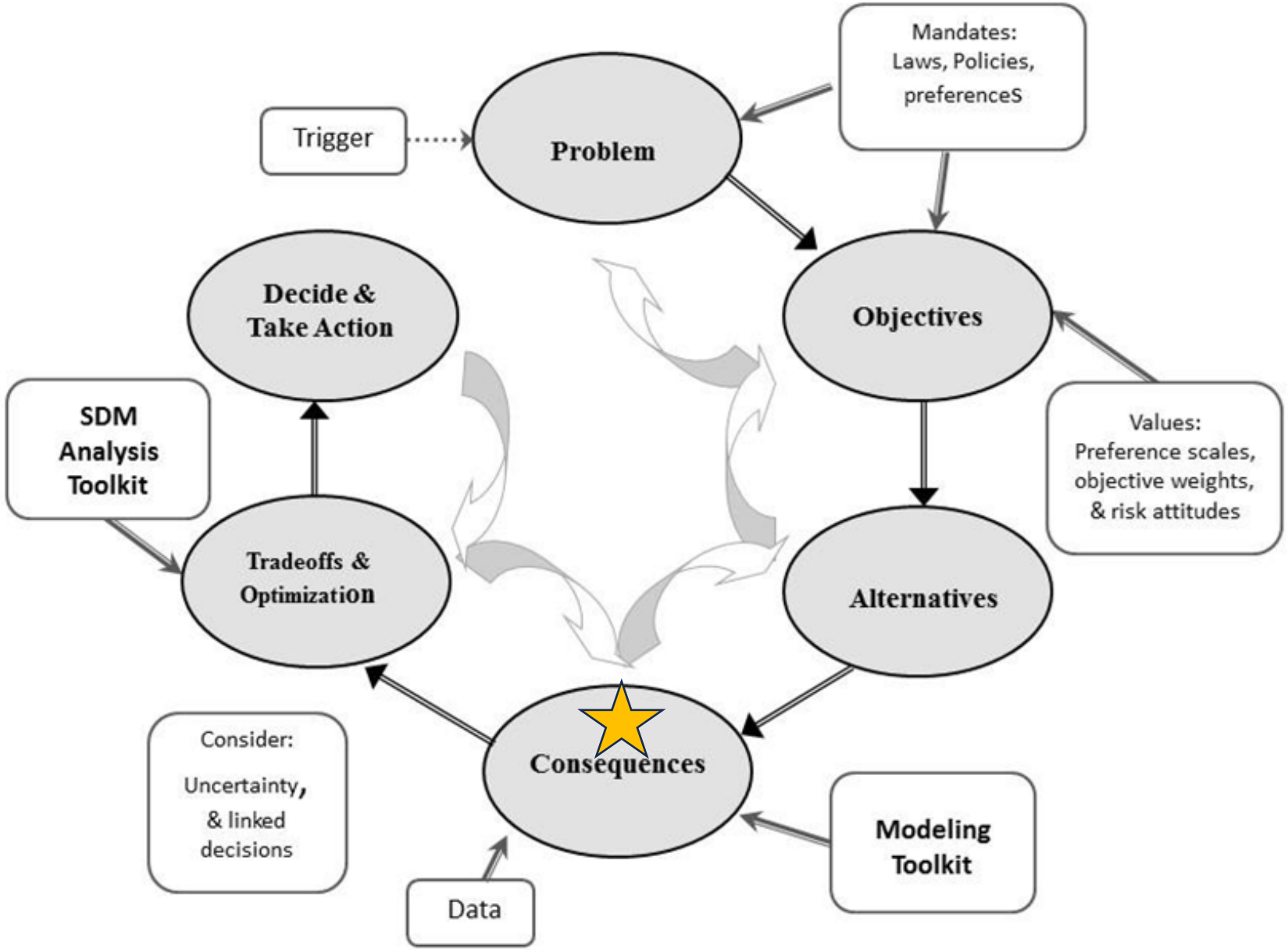
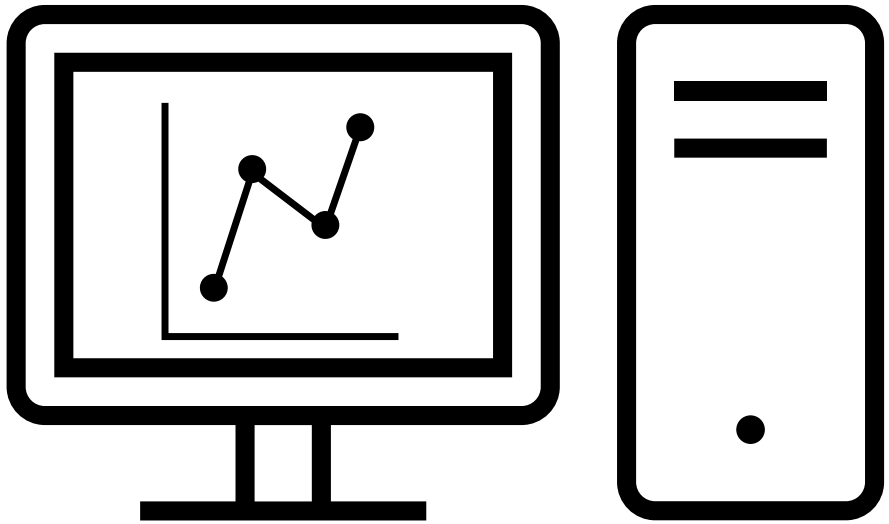


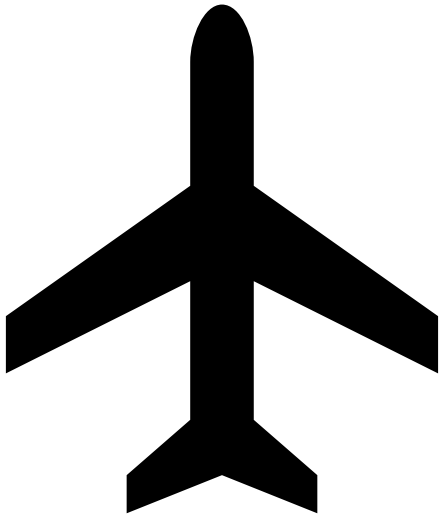
Source: Jean Fitts Cochrane

The consequences step

- Consequences link objectives and alternatives
- Models (in SDM) are tools that help us predict consequences
- Not always complex:
  - Will I make an 8:30 meeting if I leave home at 7:45?
    - The model is my experience
    - Or the model is Google maps



Simple example – set up



- I need to arrange a flight
- My objectives are:
  - Minimize price
  - Minimize flight duration
  - Minimize number of stops
  - Arrive before noon
  - Maximize quality of service
- I need to make predictions about each of these objectives
- Source of predictions:
  - Google flights: price, flight time, number of stops, and arrival time
  - TripAdvisor: airline service ratings

Simple example – **consequence table**

Objectives	Attribute	Desired Direction	Alternatives		
			1	2	3
Price	Cost	↓			
Flight time	Duration	↓			
	Number of stops	↓			
Arrive before noon	Arrival time	threshold			
Service	Service rating: 1-5 (# of raters)	↑			

Simple example – **consequence table**

Objectives	Attribute	Desired Direction	Alternatives		
			1	2	3
Price	Cost	↓	$558	$251	$391
Flight time	Duration	↓	3h 40m	5h	5h 47m
	Number of stops	↓	nonstop	1	1
Arrive before noon	Arrival time	threshold	11:11am	4:40pm	10:57am
Service	Service rating: 1-5 (# of raters)	↑	2 (2121 raters)	2 (233 raters)	3 (1875 raters)

Some Principles of Modeling in SDM

Models should

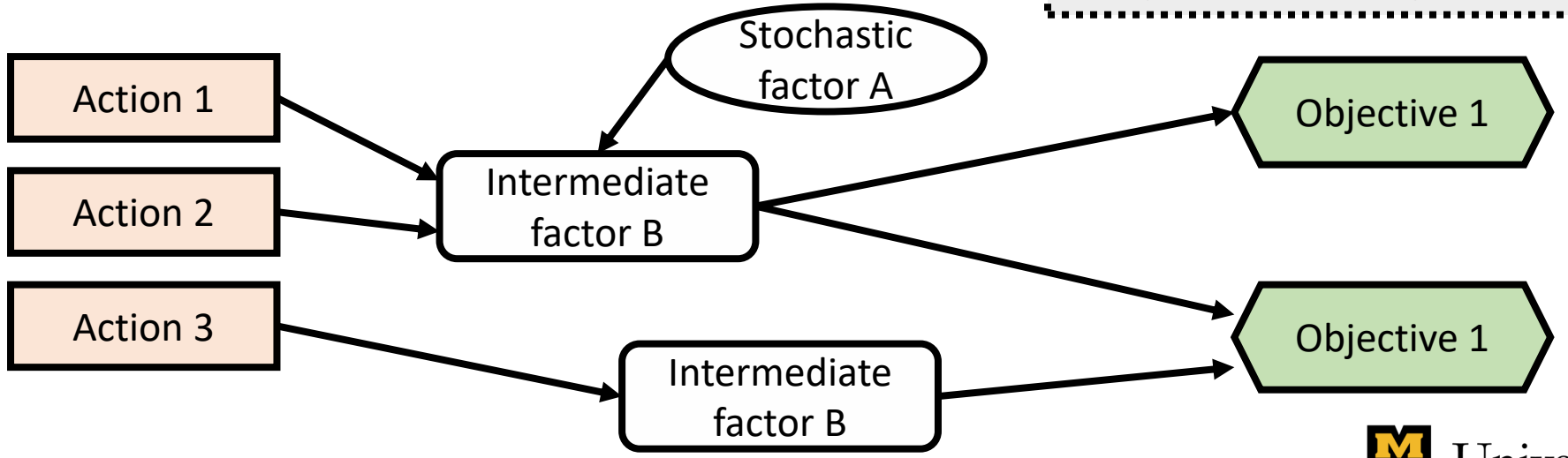
1. Include ‘hard data’ (e.g., total cost) and subjective assessment (e.g., angler satisfaction) as appropriate
2. Make the most of available information, including expert judgment
3. Report appropriate level of precision
4. Incorporate relevant uncertainty
   -Structural (broad model assumptions) e.g., density dependence?
   - Parametric uncertainty e.g., what is the parameter’s distribution?

Influence Diagrams

- Start with an influence diagram to develop a common understanding of the basic components of a model and the relationships between them

- Influence diagram:
  - Directed Acyclic Graph (DAG)
  - Conceptually link the actions to objectives
  - Distinguish between relationships of the system
  - Begin with objectives and move towards alternatives

- Actions (rectangles)
- Stochastic factors (ovals)
- Intermediate factors (rounded rectangles)
- Objectives (hexagons)



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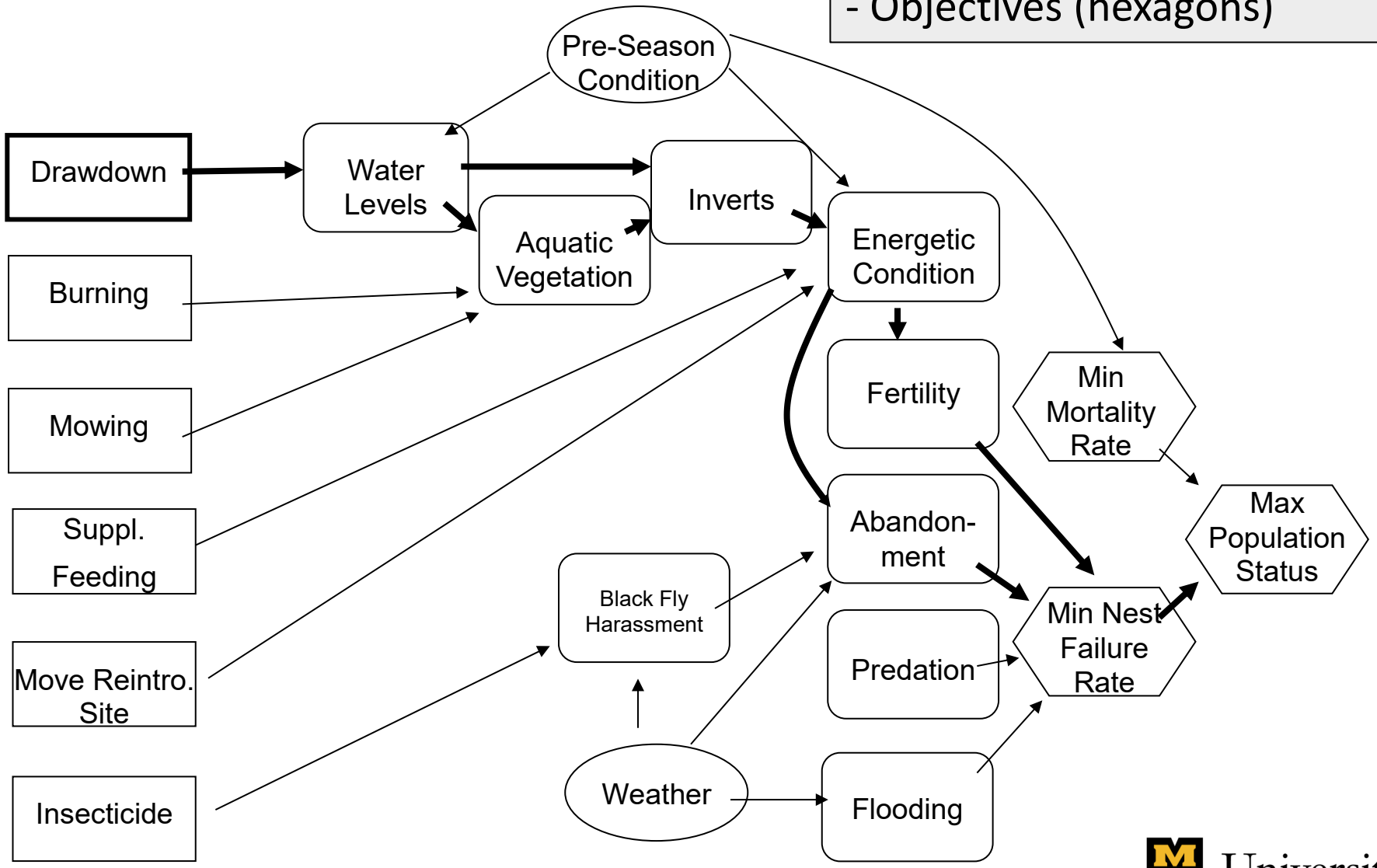
Example: Crane Nest Failure

- Actions (rectangles)
- Stochastic factors (ovals)
- Intermediate factors (rounded rectangles)
- Objectives (hexagons)



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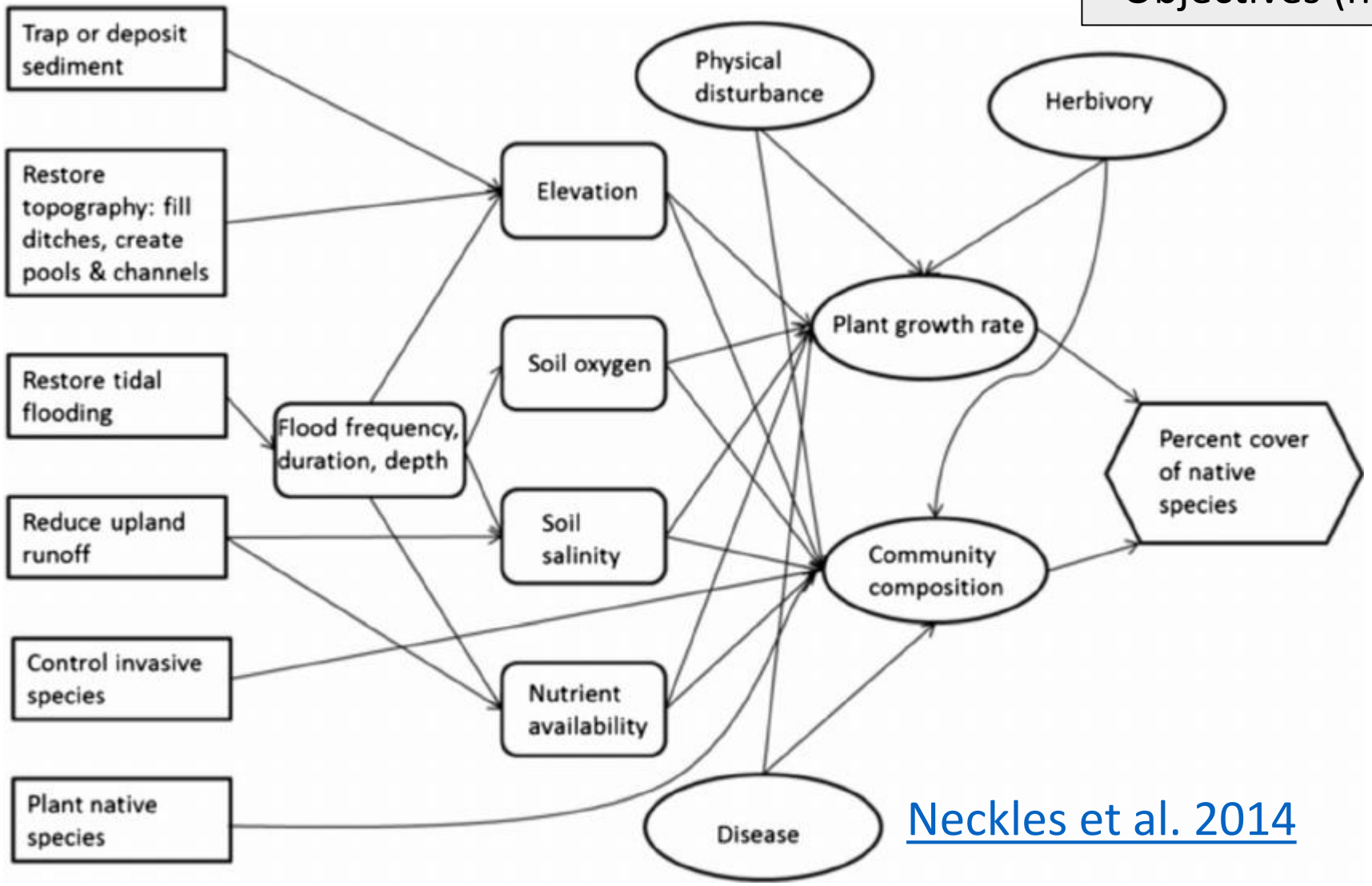
Example: Salt Marsh recovery

- Actions (rectangles)
- Stochastic factors (ovals)
- Intermediate factors (rounded rectangles)
- Objectives (hexagons)

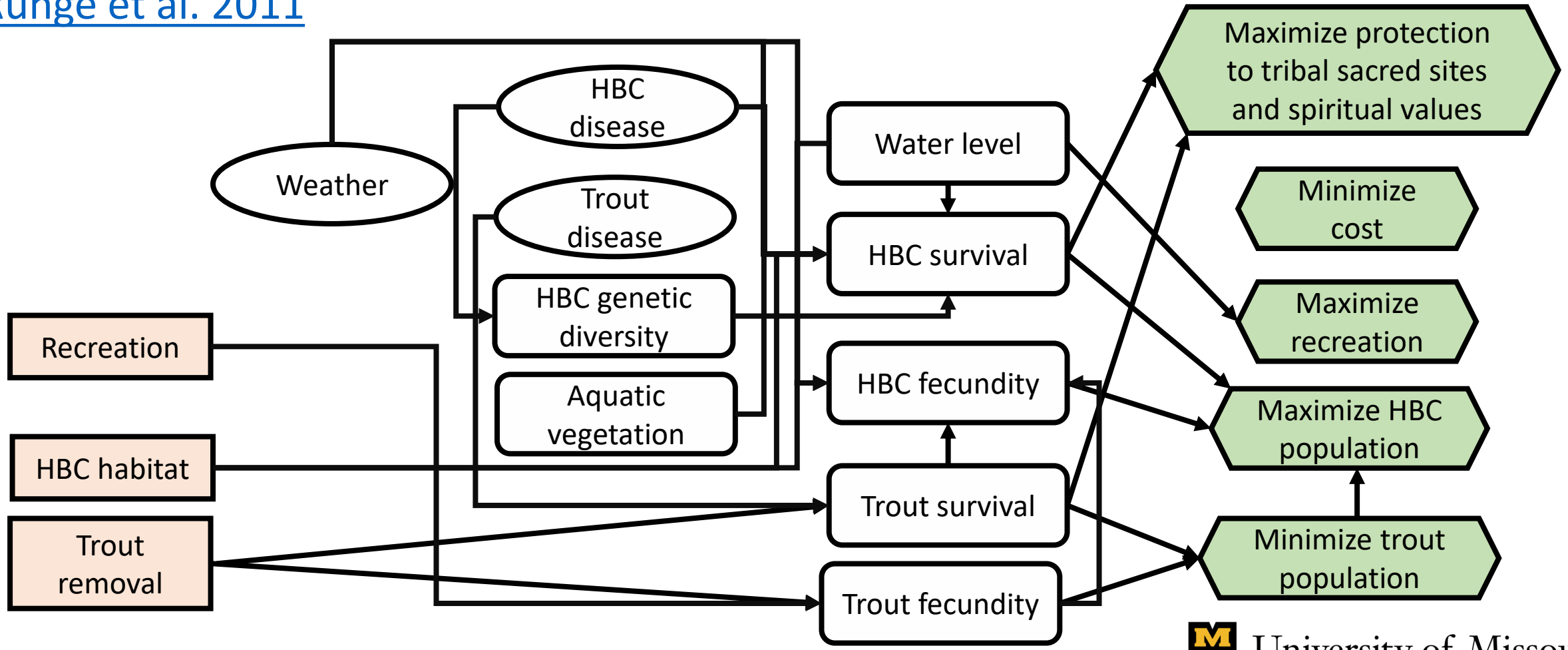


Neckles et al. 2014

Example: Influence diagram

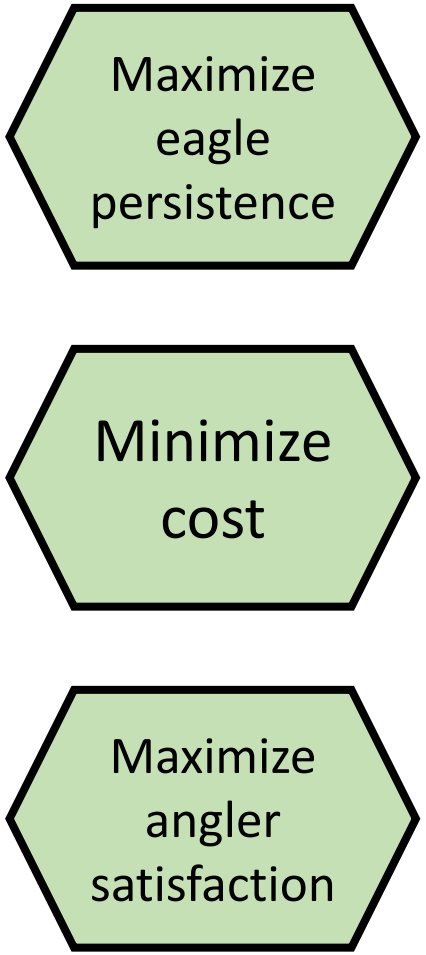
- Actions (rectangles)
- Stochastic factors (ovals)
- Intermediate factors (rounded rectangles)
- Objectives (hexagons)

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



Skills Check Task 2

- Actions (rectangles)
- Stochastic factors (ovals)
- Intermediate factors (rounded rectangles)
- Objectives (hexagons)



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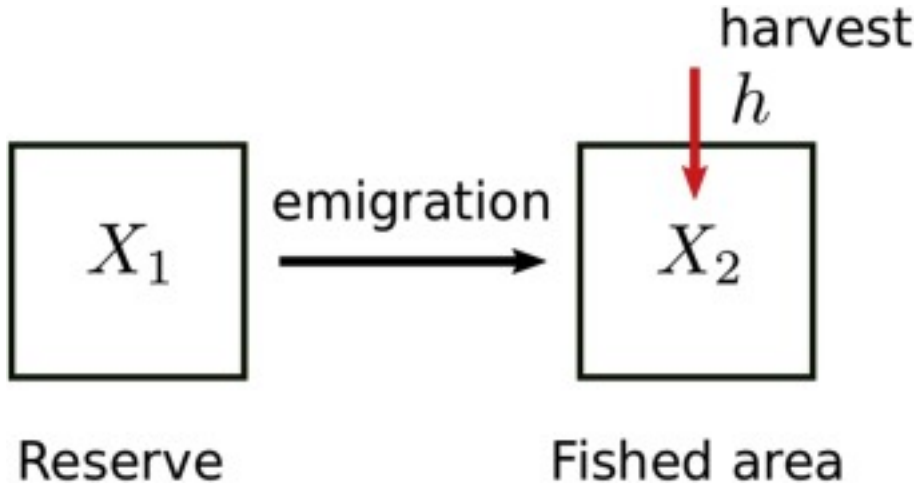
Modeling step

- A variety of models can be used to generate consequences (i.e. results)
- For example:
  - Population models (*most common)
    - Discrete time population models
    - Integrated population models
    - Occupancy models
    - Etc!
  - Statistical models
  - Empirical data
  - Expert opinion/ expert elicitation



da Silveira Costa & dos Anjos 2019

- Conduct rapid prototyping: start simple, adjust, and build up

Examples of models:

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REVIEW

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Mechanistic invasive species management models and their application in conservation

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Abstract

Management strategies to address the challenges associated with invasive species are critical for effective conservation. An increasing variety of mathematical models offer insight into invasive populations, and can help managers identify cost effective prevention, control, and eradication actions. Despite this, as model complexity grows, so does the inaccessibility of these tools to conservation practitioners making decisions about management. Here, we seek to narrow the science-practice gap by reviewing invasive species management models (ISMMs). We define ISMMs as mechanistic models used to explore invasive species management strategies, and include reaction-advection–diffusion models, integrodifference equations, gravity models, particle transport models, nonspatial and spatial discrete-time population growth models, cellular automata, and individual-based models. For each approach, we describe the model framework and its implementation, discuss strengths and weaknesses, and give examples of conservation applications. We conclude by discussing how ISMMs can be used in concert with adaptive management to address scientific uncertainties impeding action and with multiple objective decision processes to evaluate tradeoffs among management objectives. We undertook this review to support more effective decision-making involving

Thompson
et al. 2021

https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/csp2.533

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Consequence table

- Consequence tables = A convenient way to display predictions for multi-objective decisions
  - Matrix of predictions by objective and alternative
  - Can give us an overall sense of our alternatives
  - Facilitates solving multi-objective decisions

	Alternative 1	**Alternative 2**	**…**	**Alternative n**
Objective 1	*prediction*	*prediction*		*prediction*
Objective 2	*prediction*	*prediction*		*prediction*
…				
Objective m	*prediction*	*prediction*		*prediction*

Example: consequence table

Gregory R and Long G. 2009. Using structured decision making to help implement a precautionary approach to endangered species management. Risk Analysis 29:518-532.

Objective	Attribute	Direction	Units	Status Quo	Preservation	Commercial	Terminal Benefits	Spread the Pain 1	Spread the Pain 2	Max Rebuilding	Spread the Pain 3	Sports Compromise
Conservation	% meeting Rec Plan Objective 1	H	%	73%	76%	82%	80%	72%	80%	84%	79%	81%
Conservation	% meeting Rec Plan Objective 2	H	%	32%	33%	33%	34%	31%	35%	34%	33%	34%
Conservation	No of returns in 2010	H	# 000	6.3	7.8	12.5	8.7	6.5	8.6	13.2	8.0	8.9
Conservation	No of returns in 2016-2019 (ave)	H	# 000	16.9	24.3	47.7	31.1	16.8	30.1	53.8	28.7	35.7
Conservation	Probability of extinction	L	%	2.4%	1.1%	0.0%	0.3%	3.4%	0.2%	0.0%	0.4%	0.2%
Conservation	% Enhanced fish 2010	L	%	27%	21%	56%	34%	26%	35%	52%	37%	46%
Conservation	% Enhanced ave fish 2016-2019	L	%	33%	29%	45%	41%	32%	42%	41%	45%	46%
Costs	Total Costs	L	!Yr Av Ave $00	$ 171	$ 309	$ 588	$ 488	$ 171	$ 523	$ 588	$ 328	$ 500
Catch	Total Downstream	H	# 000	1,925	304	6,601	3,391	3,391	4,642	1,925	4,618	4,642
Catch	Total Upstream	H	# 000	637	2,884	504	2,365	2,365	2,335	3,054	2,131	2,335
Catch	Total First Nations	H	# 000	777	739	769	796	796	768	797	768	768
Jobs	Total FTEs	H	# FTEs	1.60	2.80	4.10	3.70	1.60	3.30	4.10	2.50	4.10

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Developed by Sarah J. Converse

Example: consequence table

Post van der Burg, M., and M. E. Colvin. 2024. Using structured decision making to assess management alternatives to inform the 2024 update of the Minnesota Invasive Carp Action Plan. Report 2024-1020, Reston, VA. https://pubs.usgs.gov/publication/ofr20241020

Objective	Mean weight	Strategy																	
		1	8	12	5	7	6	9	10	2	4	18	13	17	16	14	15	3	11 (optimal strategy)
Decrease invasive carp abundance	0.13	1.75[a]	6.31	3.84	5.56	6.25	5.28	4.94	5.94	3.44	4.63	7.69	6.22	8.23	6.94	6.38	7.13	8.63[b]	6.56
Minimize negative effects on native mussels	0.07	4.38[a]	6.50	7.13	6.75	7.38	6.56	6.00	6.69	5.19	6.56	7.38	7.13	7.63	6.97	7.50	6.94	8.50[b]	6.88
Minimize effects to native fish	0.13	3.63[a]	5.56	6.50	5.50	5.81	5.44	5.38	5.75	4.44	5.41	6.56	6.22	6.69	6.34	6.56	6.44	7.38[b]	6.31
Minimize effects to native flora	0.07	6.25[a]	6.81	7.81	6.56	6.88	7.06	6.88	7.22	6.69	6.56	7.63	7.56	7.72	7.72	7.44	7.84	8.19[b]	7.56
Maintain recreational opportunities	0.09	4.00[a]	5.38	5.03	5.03	5.50	5.34	5.63	5.38	5.41	5.88	6.56	7.09	6.69	6.81	6.81	6.81	7.48[b]	6.50
Minimize negative effects to Minnesota river-based economies	0.07	3.75[a]	6.63	5.22	5.56	6.38	5.47	5.81	6.38	5.03	5.19	7.25	7.16	6.94	6.75	6.13	6.63	8.48[b]	6.75
Minimize carp threats to public safety	0.08	4.00[a]	6.44	4.97	5.91	6.19	6.16	6.00	6.63	5.16	5.56	7.88	6.91	7.75	7.13	6.88	7.13	8.04[b]	6.75
Minimize management threats to public safety	0.07	9.25[b]	7.63	8.13	7.50	7.50	7.75	7.75	7.50	8.88	8.25	7.38	8.50	7.50	7.38	7.69	7.50	5.94[a]	8.25
Minimize negative effect to cultural practices	0.07	5.63[a]	6.75	5.81	6.75	7.13	7.13	6.88	6.94	7.25	7.25	6.88	7.38[b]	7.00	7.13	7.38[b]	7.13	7.38[b]	7.00
Maintain access for underserved populations	0.06	7.13[a]	8.00	7.91	8.31	8.25	8.50	8.44	8.50	8.38	8.75[b]	8.13	8.63	8.25	8.50	8.25	8.63	8.38	8.50
Minimize prevention and control costs of the action	0.07	8.75[b]	2.25	5.57	4.44	2.00	4.13	5.56	3.16	7.81	6.50	1.64	4.38	1.64	3.29	5.07	3.29	0.50[a]	5.21
Minimize implementation time	0.10	10.00[b]	2.31	3.81	3.63	2.13	3.31	3.56	2.88	10.00[b]	6.75	2.13	2.38	2.00	4.13	3.88	4.44	1.13[a]	7.13
Total score	--	**5.41**	**5.75**	**5.76**	**5.79**	**5.81**	**5.81**	**5.85**	**5.91**	**6.22**	**6.23**	**6.36**	**6.44**	**6.46**	**6.50**	**6.54**	**6.58**	**6.66**	**6.86**

[a]Maximum score of an objective (shaded yellow).

[b]Minimum score of an objective (shaded red).

University of Missouri

Developed by Mike Colvin

Models used in a Structured Decision: Example

SDM project: Non-native fish control below glen canyon dam to aid in humpback chub (HBC) recovery

Arizona Department of Education

Case study: (Runge et al. 2011)

University of Missouri

Developed by Mike Runge

Models used in a Structured Decision: Example

OBJECTIVES

	Alternative	Respect Life	HBC Recovery	Wilderness Disturbance	Cost
		0-10 scale	P(N>6000)	User-days	M$/5-yr
		Max	Max	Min	Min
A	No action	6.00	0.232	0	0
C_2	LCR removal (lethal)	6.33	0.343	5003	3.17
C_3	LCR removal (mix)	6.33	0.341	5037	3.53
C_4	LCR removal (live, boat)	9.67	0.341	5003	3.38
C_5	LCR removal (live, heli)	9.67	0.341	5154	4.65
D_1	Removal curtain (lethal)	8.00	0.532	6824	3.47
D_2	Removal curtain (mix)	6.33	0.532	6824	3.98
D_3	Removal curtain (live)	9.67	0.532	6867	4.36
J_1	Kitchen Sink I	1.67	0.555	6753	3.43
J_1'	Kitchen Sink I w/ stock	1.67	0.536	6777	3.62
J_2	Kitchen Sink II	1.67	0.555	6793	4.08
J_2'	Kitchen Sink II w/ stock	1.67	0.536	6818	4.32
K	Zuni-Hopi-NPS	9.00	0.291	5400	3.03

Runge MC, Bean E, Smith DR, Kokos S. 2011. Non-native fish control below Glen Canyon Dam—report from a structured decision-making project. U.S. Geological Survey Open-File Report 2011-1012, 74 p.

University of Missouri

Developed by Mike Runge

Models used in a Structured Decision: Example

Objective 1: Be respectful of non-human life

Reflects a value that taking life (rainbow trout, an invasive species) should be purposeful and done with good intent

Measurable attribute (constructed scale):

10-point constructed scale considers the relative degree of respectfulness for the proposed end uses of fish taken

0 = strong lack of respect for the lives of the fish taken

10 = strong respect for the lives of the fish taken

Model: expert elicitation

Representatives from three tribes scored the alternatives on this objective, integrating their cultural understanding

Runge MC, Bean E, Smith DR, Kokos S. 2011. Non-native fish control below Glen Canyon Dam—report from a structured decision-making project. U.S. Geological Survey Open-File Report 2011-1012, 74 p.

Developed by Mike Runge

Models used in a Structured Decision: Example

Objective 2: Contribute to humpback chub recovery

Measurable attribute (natural scale):

Probability of the adult humpback chub population remaining above 6000 over the next 30 years

Model: Fish community dynamics

Dynamics modeled in the Colorado River (LCR) below Glen Canyon Dam with a Population Viability Analysis (three sub-models)

Runge MC, Bean E, Smith DR, Kokos S. 2011. Non-native fish control below Glen Canyon Dam—report from a structured decision-making project. U.S. Geological Survey Open-File Report 2011-1012, 74 p.

Developed by Mike Runge

Models used in a Structured Decision: Example

Objective 3: Minimize disturbance of wilderness experience as a result of non-native fish management in Grand Canyon NP wilderness

Measurable attribute (constructed scale):

Penalized user-days/year in the wilderness area during boat/helicopter trips for removal.

Staff size*number of days*penalty factors (for activities that result in greater disturbance)

Model: Nonnative fish population model

Included predictions of how many removal trips would be needed each year; multiply by the average staff size of a removal trip, the average length of a trip, and penalty factors

Runge MC, Bean E, Smith DR, Kokos S. 2011. Non-native fish control below Glen Canyon Dam—report from a structured decision-making project. U.S. Geological Survey Open-File Report 2011-1012, 74 p.

Developed by Mike Runge

Skills Check Task 3

		Alternative Strategies			
Objective	**Measurable attribute**	**Strategy 1:**	**Strategy 2:**	**Strategy 3:**	**Strategy 4:**
Maximize eagle persistence	# of eagles after 1 year				
Minimize cost	$				
Maximize angler satisfaction	Constructed scale				

A. Fill in the consequence table and score each outcome of each objective (it's okay to make up these numbers)

B. What type of models would you use to calculate each of the objectives. Is there another objective that comes to mind for this problem? How would you calculate that one?

Developed by Brielle Thompson

Activity: think about your decision problem

- For your final project presentation, you will provide a slide of your Alternatives
  - Can you generate alternatives?
  - Can you think of portfolios or strategies for your problem?

- & You will provide a slide of your Consequences
  - Can you create an influence diagram?
  - Can you create a consequence table?
    - Don't worry about filling it in with real #s

- **Feel free to go back to your problem framing & objective steps!**

Looking ahead:

Next week: T step of PrOACT

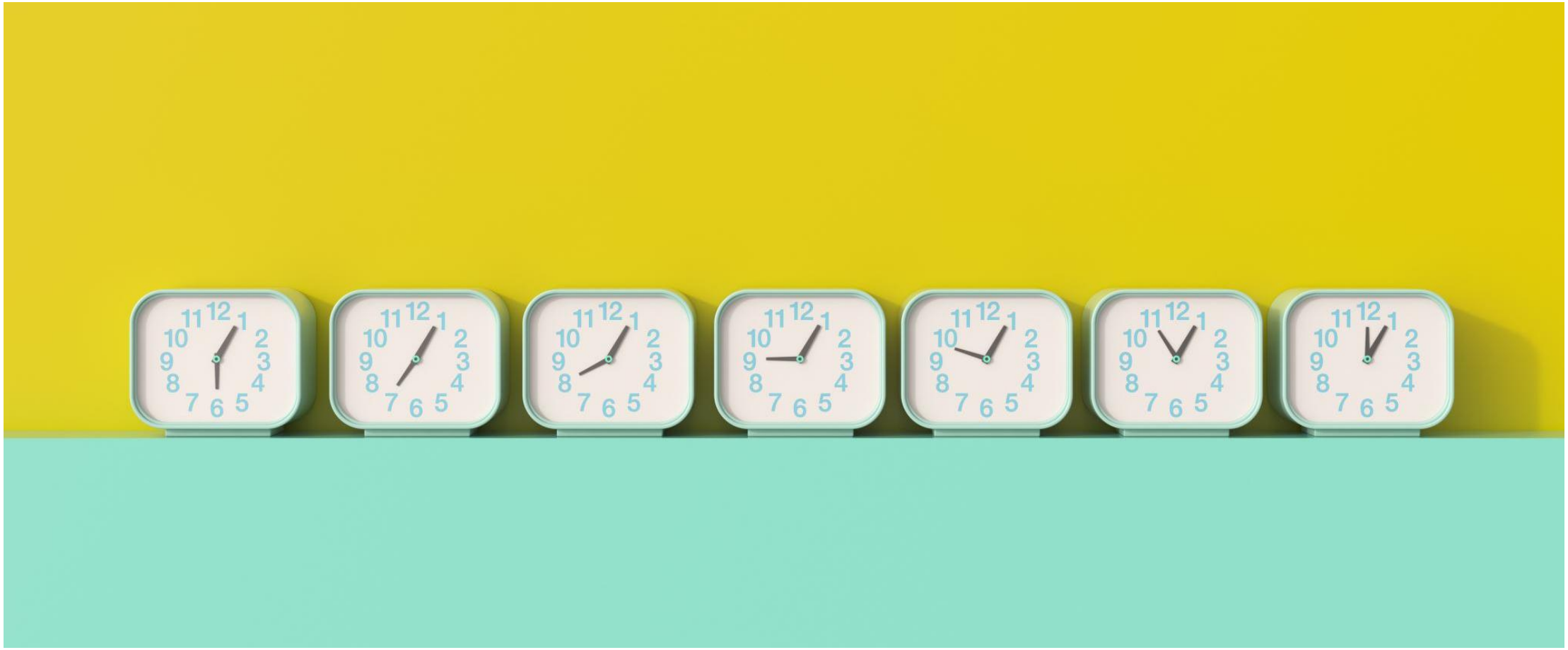
Weekly: Work through a step of the PrOACT process/ learn extra tools

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:



Activity

Developed by: Alex McInturff, Angela Matz, Mitch Eaton, Paul Barrett, Sarah J. Converse

Impoundment Repair

Problem

- Decision maker: Refuge manager who is also interested in stakeholder's perspectives
- Trigger: Weir is not functioning adequately
- Actions: Status quo, Minor or Major weir repair, Rebuild Impoundment
- Constraints: Facilities funding available this year, not sure about future funding
- Frequency and Timing: One time decision, but could be revisited in the future if funding is available
- Scope: The impoundment and areas affected by the project
- Problem class: Multiple objective with uncertainty

Activity

Developed by: Alex McInturff, Angela Matz, Mitch Eaton, Paul Barrett, Sarah J. Converse

Impoundment Repair
Objectives

Objective	Direction	Performance measure
Cost	Minimize	Dollars ($M)
Environmental benefits	Maximize	Constructed scale (0 to 10)
Disturbance	Minimize	Constructed scale (0 to 10)
Silt runoff	Minimize	Thousand cubic feet (k ft^3)
Water retention	Maximize	Million gallons (MG)

Activity

Developed by: Alex McInturff, Angela Matz, Mitch Eaton, Paul Barrett, Sarah J. Converse

Impoundment Repair
Alternatives

- What are the alternatives for this problem?
- Are there additional alternatives? How would you develop them?

You are the manager of a National Wildlife Refuge and are in the process of deciding how to manage for an endangered lizard on the Refuge. The lizard seems to benefit from the disturbance associated with prescribed fire (though your budget for such activities is limited). Also, the species is susceptible to mortality on roads, but the Refuge receives substantial visitation by bird watchers, some of whom like to travel by car.

Given objectives:

- Minimize probability of extinction of the lizard
- Increase use of prescribed fire
- Minimize costs
- Minimize lizard road mortality
- Maximize birder satisfaction
- Maximize native bird species richness

Given alternatives:

- Spatial/temporal variations of road closures and prescribed burns

Identify characteristics of the models we would want to build, including: Inputs, Outputs, Model types

Activity

Reading discussion