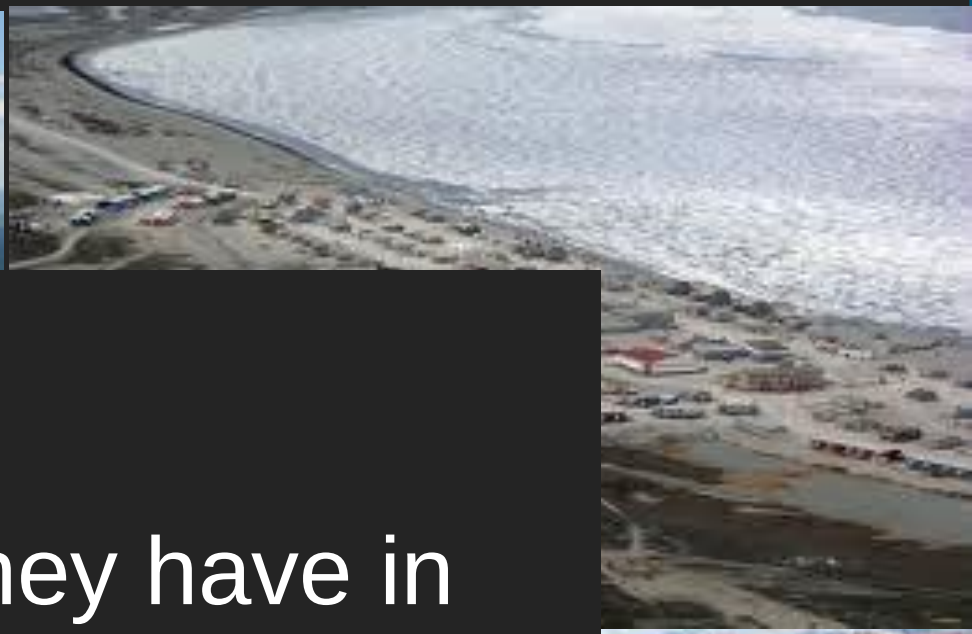
FUTURES 2014

WHAT CAN DECISION ANALYSIS DO FOR YOU?

What do they have in common?


Complex Science
Uncertainty
High Stakes
Entrenched Positions
CHOICES
Intense Public Scrutiny
$
Tough Trade-offs
Jurisdictional Overlap
Polarized Values
Multiple Stakeholders
HARD DECISIONS

The Idea

When you frame your problem as a decision –

a choice with multiple objectives and alternative courses of action – it changes your point of entry into the problem and, consequently…

… it changes everything you do

- The make up of your project team
- The allocation of resources
- The collection of information
- The focus of uncertainty analyses
- The timing and methods for engaging stakeholders

A Species Recovery Plan

Scientific studies

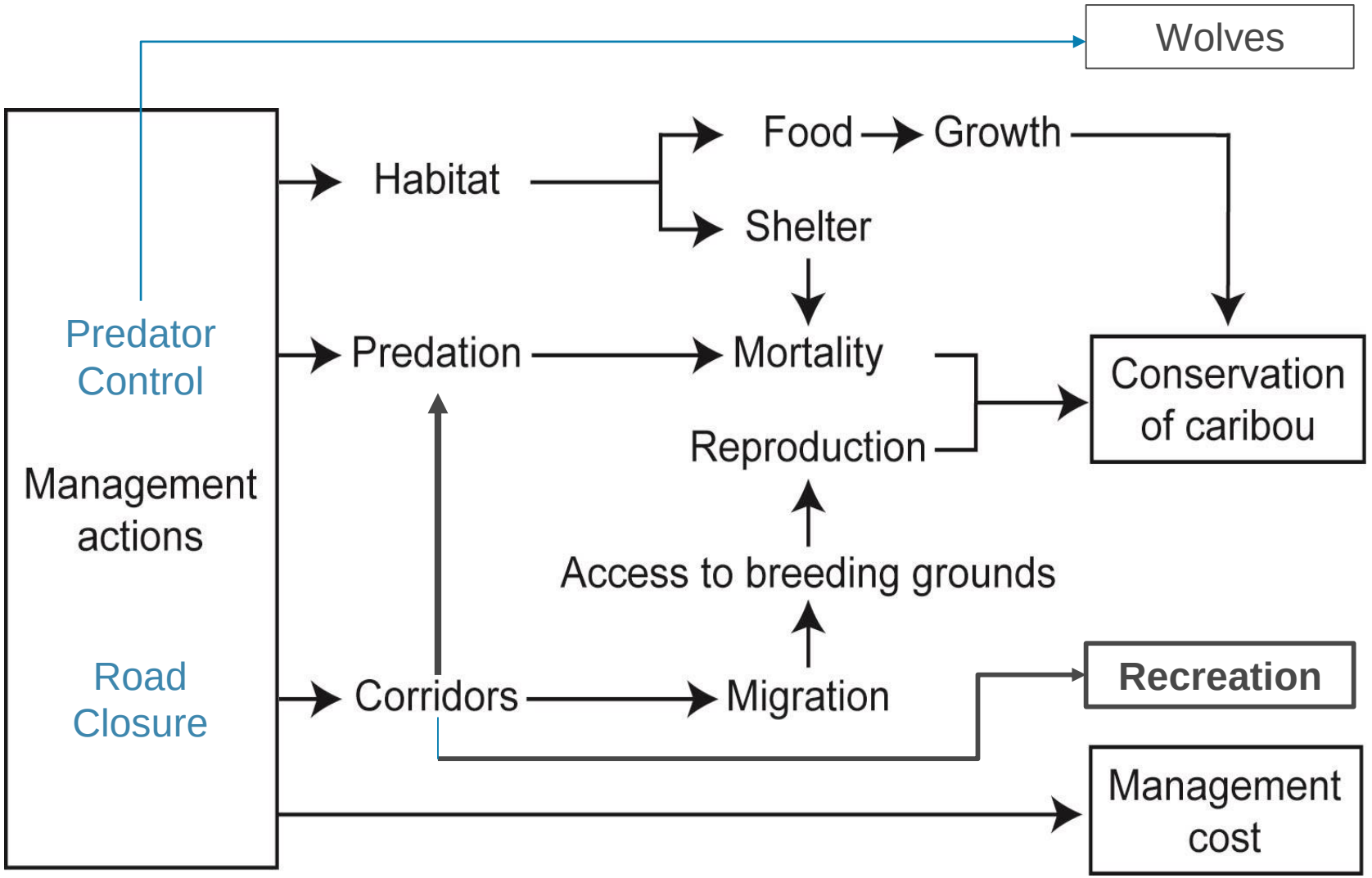
Decision relevant studies

Sketch the Decision

Pre-Sketch Framing

Objectives	Baseline Studies
abundance	✓
probability of persistence	✓
habitat	✓
food	✓
mortality	✓

Influence Diagram



Post Sketch Framing:
A Consequences Table

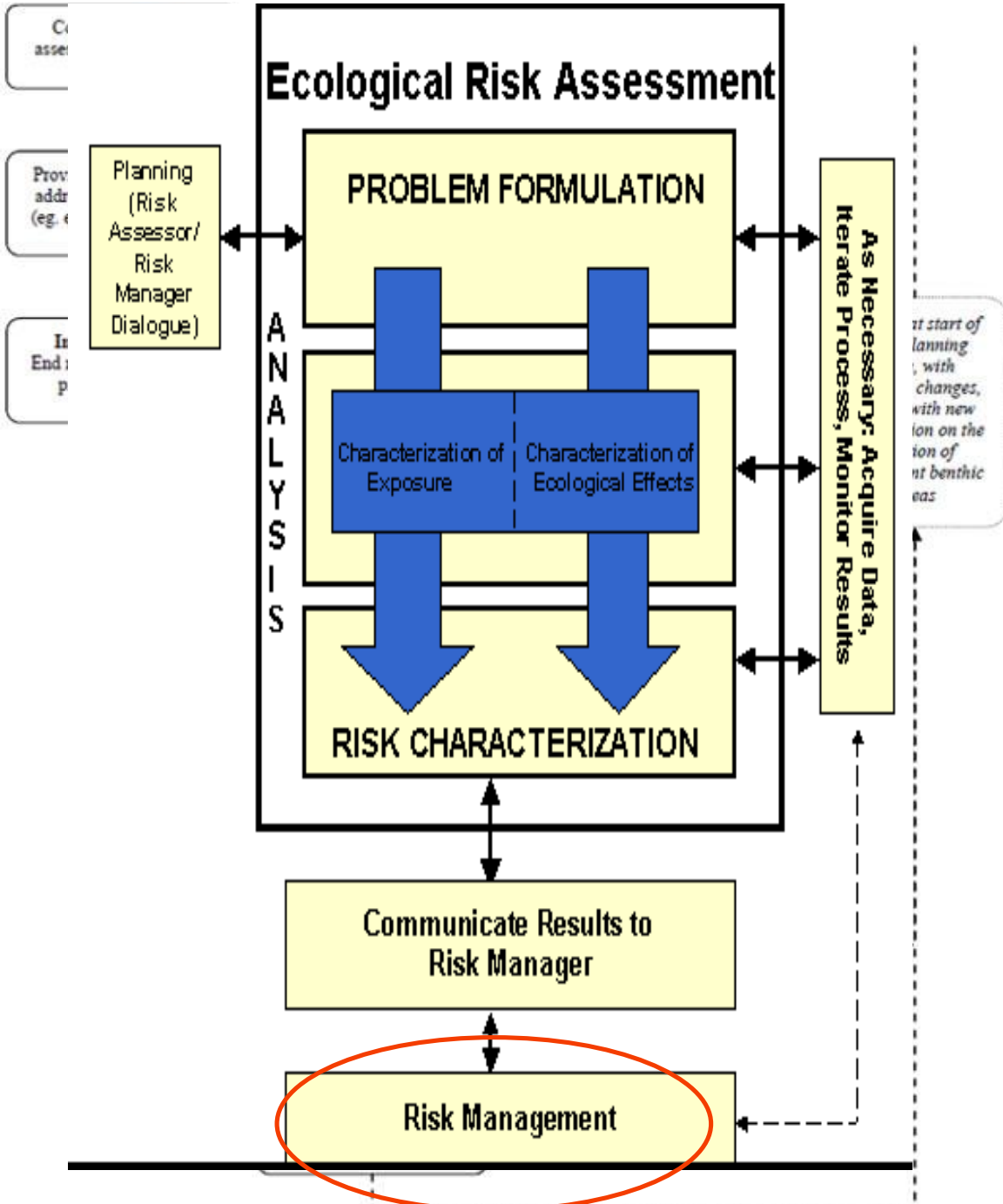
	Habitat Protection	Predator Control	Road Closures …
Caribou			
Wolves			
Recreation			
Local Business			
Cost to Government			

Or…Kai's example…
A Consequences Table

	ITQ	Derby	Other?
Stock sustainability			
Total economic value			
Coastal employment			
Business ownership			
Subsistence catch			

Key Message: Sketch the Decision

But there's little guidance on decision making….



Today

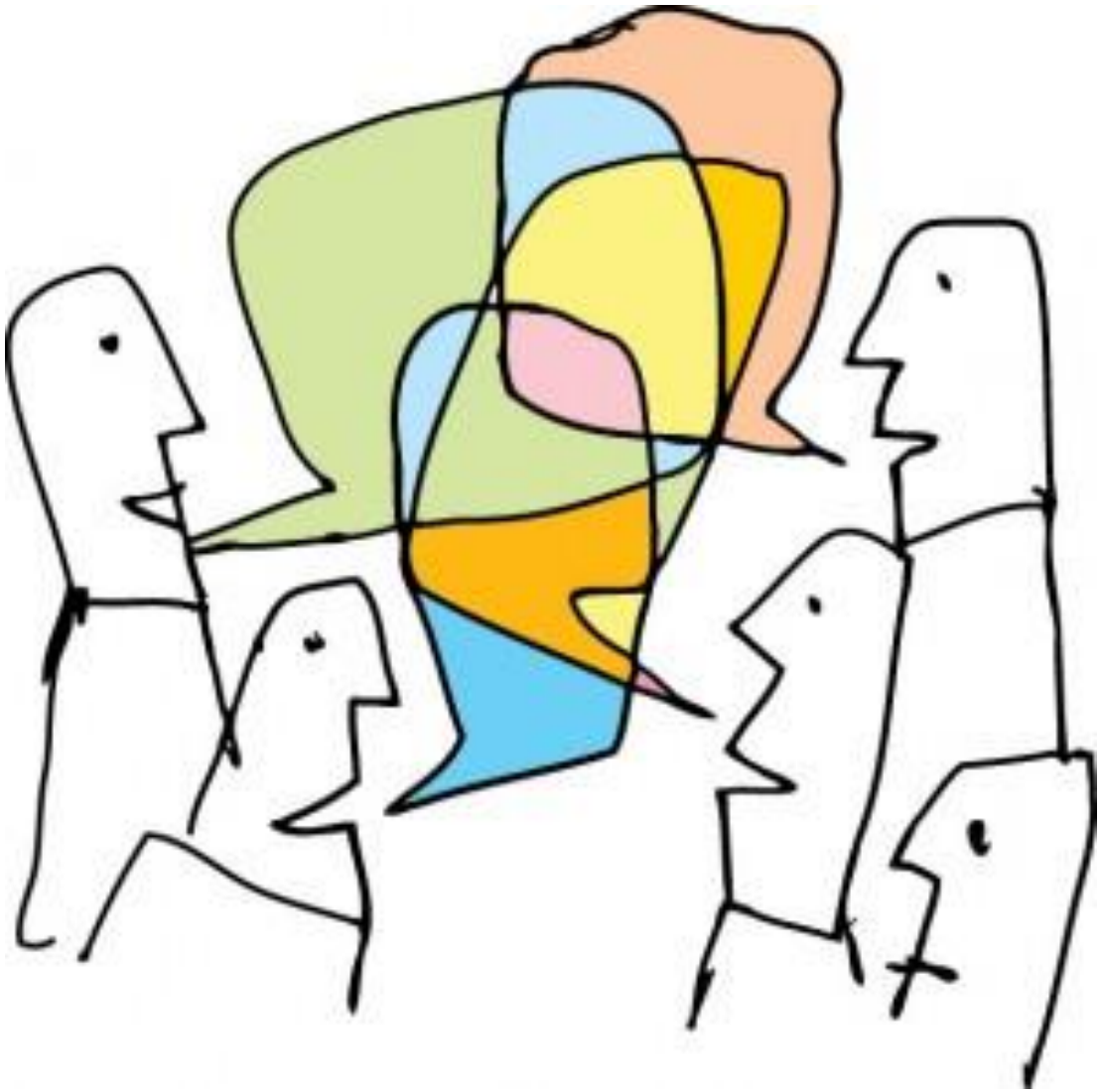
- Decision Traps
  - Barriers to using good science in decision making
- Structured Decision Making
  - An approach from the decision sciences
- Key Messages

Some traps that prevent the uptake of science in decision making

DECISION TRAPS

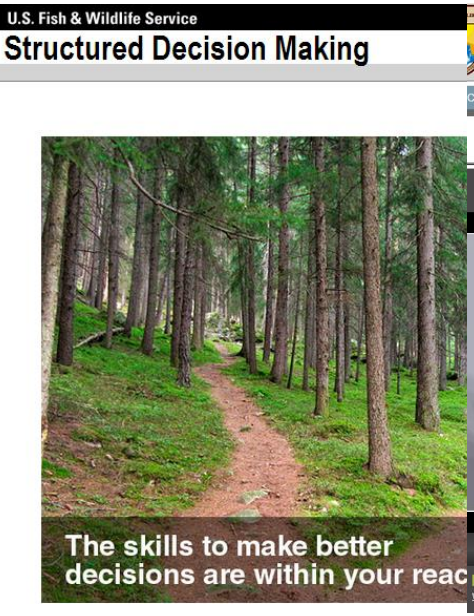
CAN YOU NAME THEM?

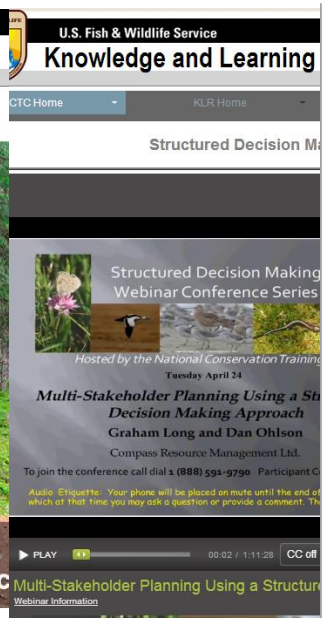

HARVESTORE
CROPSTORE

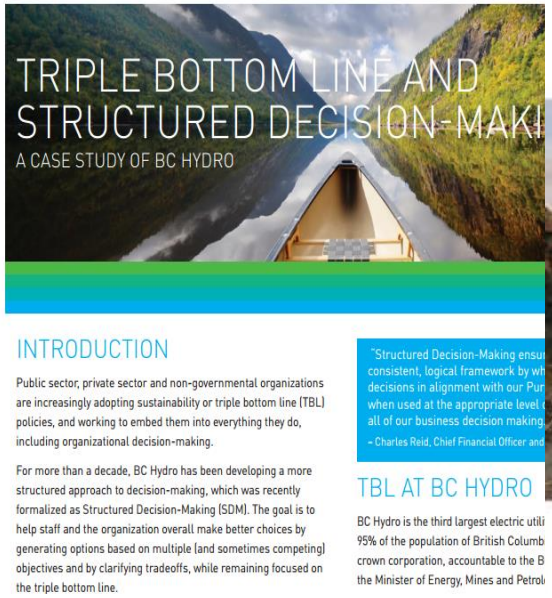


Common Decision Traps

- Working in Silos
- Lack of Level Playing Field
- The Power Play
- Ambiguity
- Gut Feel
- Anchoring & Positioning
- Groupthink
- Hostage-taking
- The Goldilocks
- The Stall and Study
- The End Run

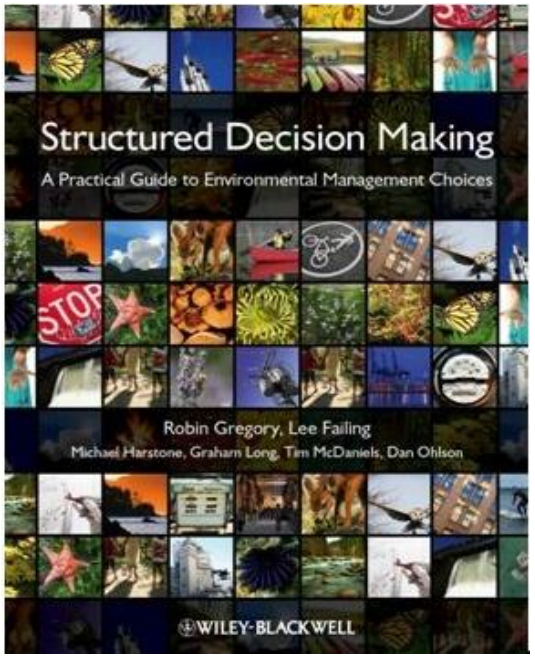






Structured Decision Making

SDM



What is SDM?

An organized framework for helping people, especially **groups**, identify creative options and make informed, **defensible** and **transparent** choices

SDM is…

Based in the decision sciences

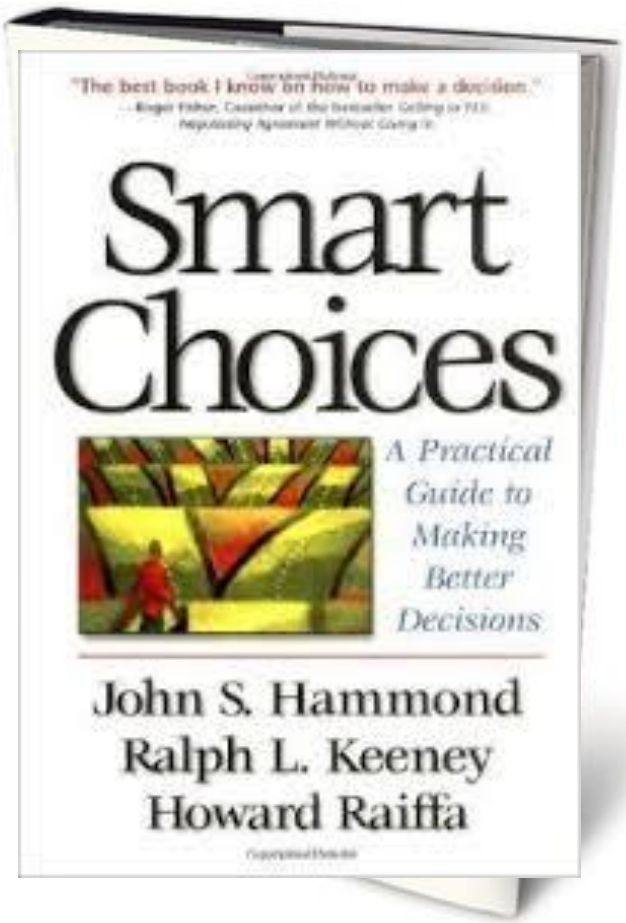
- A set of core steps
- A set of structuring tools

Adapted for the real world

- Practical, scalable and iterative
- Helps avoid “decision traps”

Recognized best practices

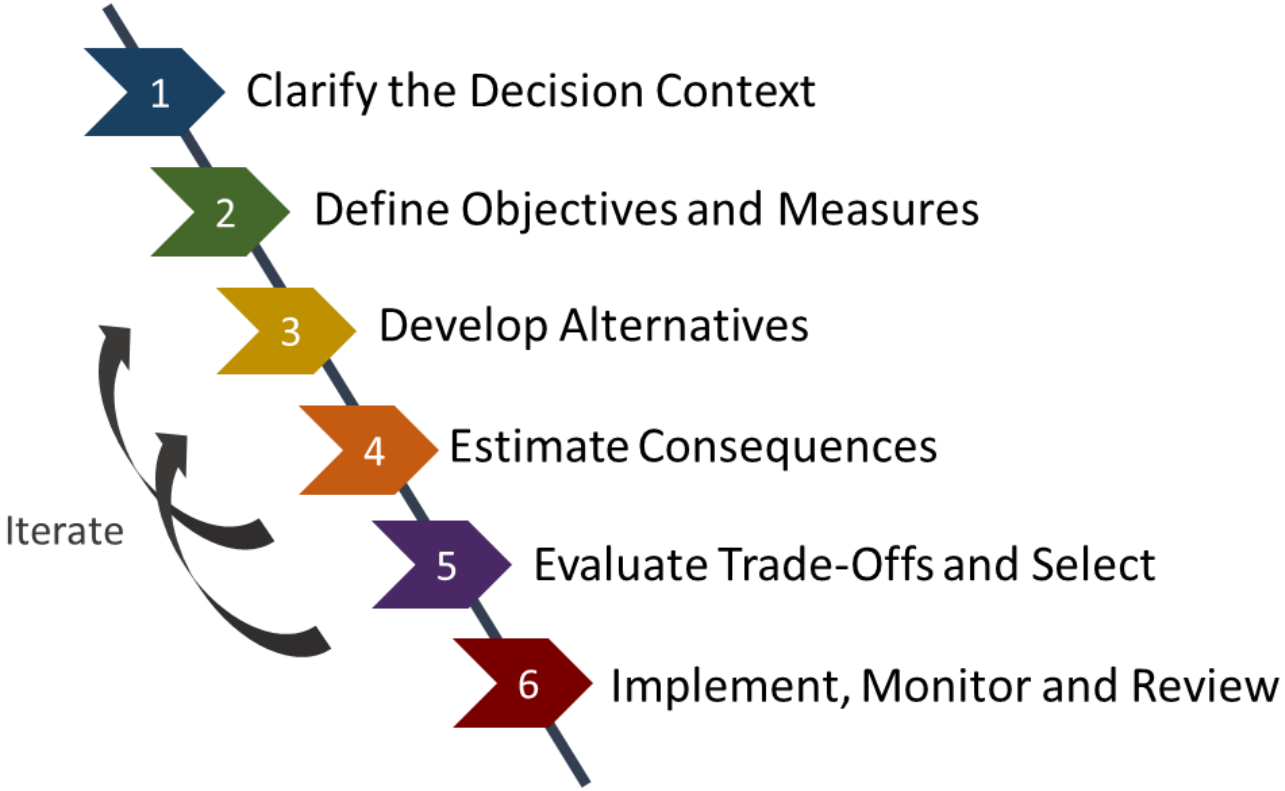
- Analysis and deliberation
- Facts and values



Steps of SDM

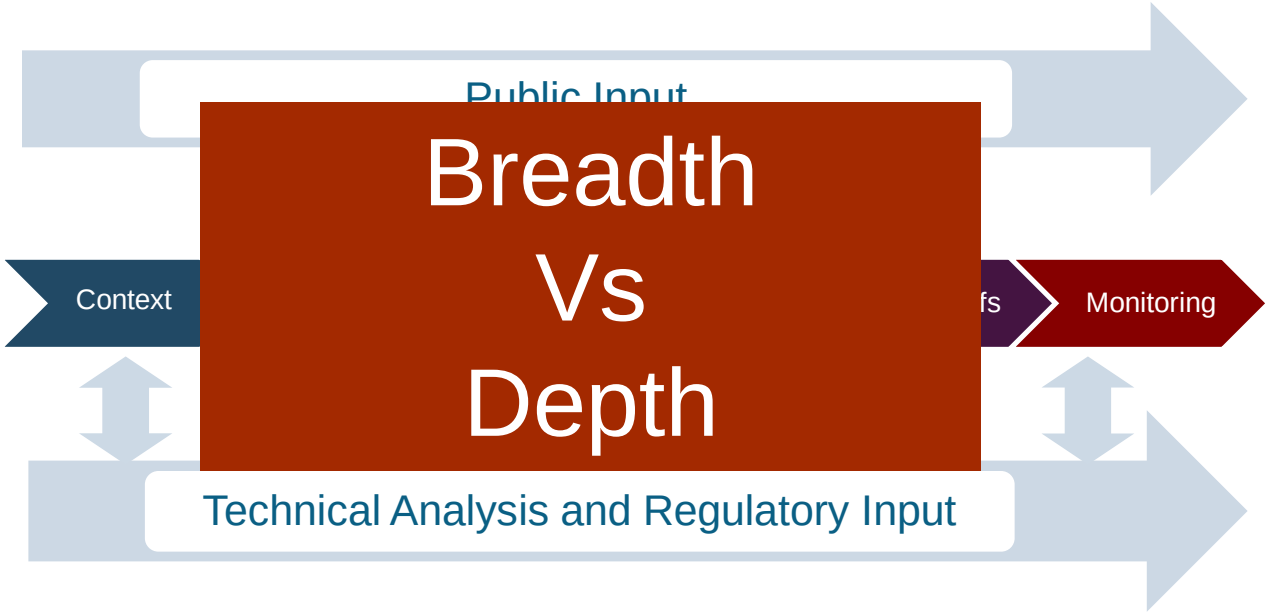
"Decision analysis is formal use of common sense for problems that are too complicated for informal use"

Ralph Keeney



SDM integrates…

- Technical analysis with engagement process
- Small group engagement with broader public engagement

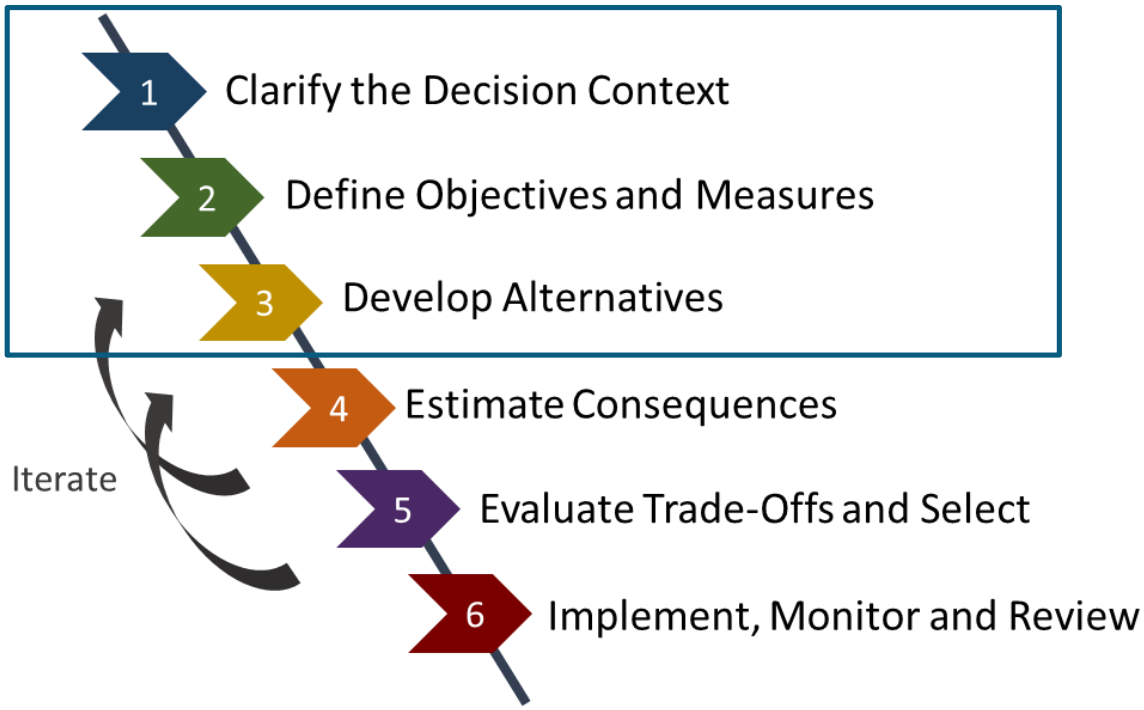


What Decision Analysis Can Do for You

SDM LESSONS

Sketch the Decision

- What decision is being made? By whom?
- What's in and out of scope?
- What kind of technical analysis is needed? What are the key gaps?
- What kind of engagement is needed?



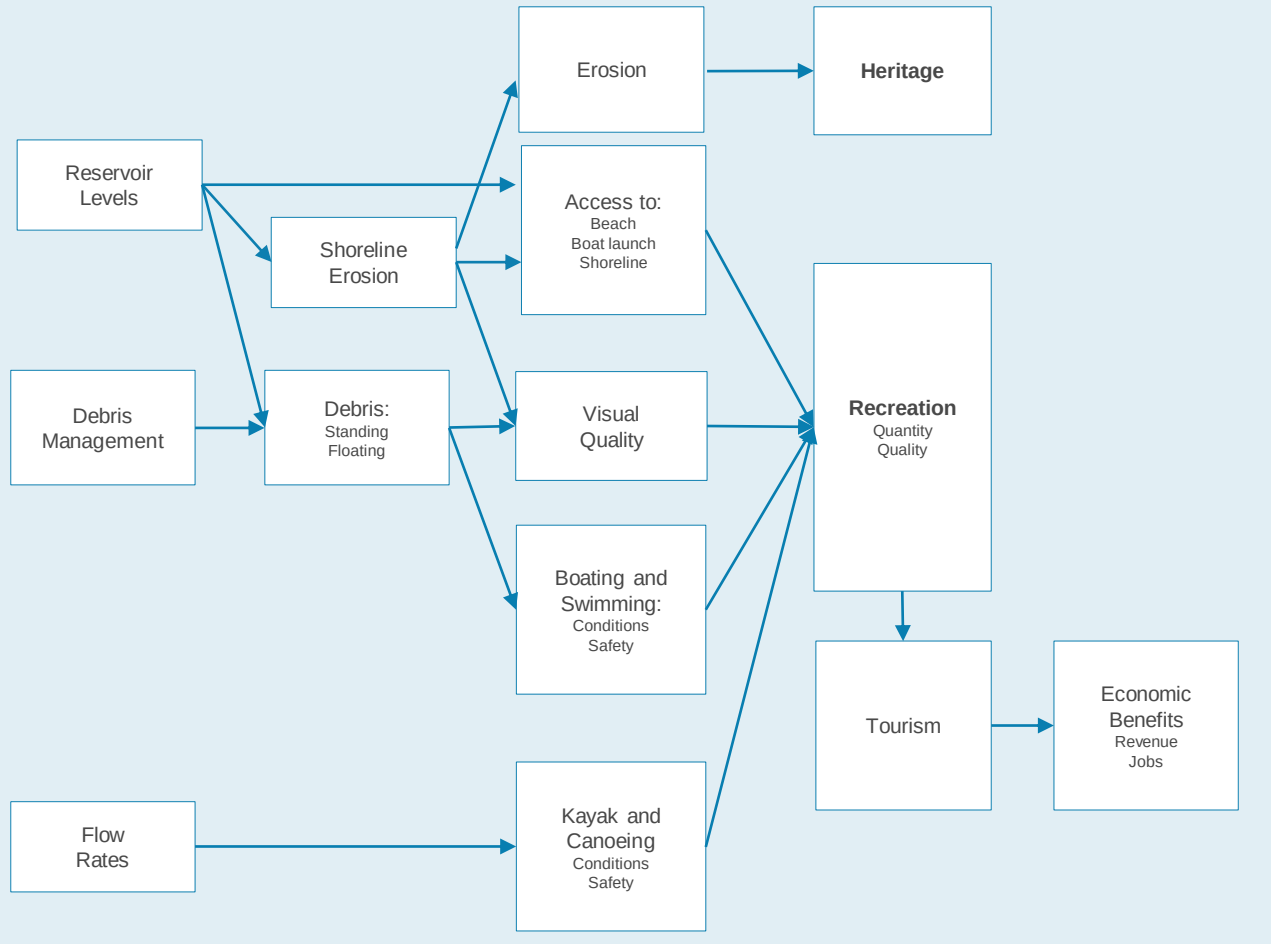
From the sketch:

- A road map
- Integrated process
- Insight into likely trade-offs and uncertainties
- Terms of reference

	Habitat Protection	Predator Control	Road Closure
Caribou			
Wolves			
Recreation			
Local Business			
Cost to Govt			

Define a concise set of Objectives

Objectives and performance measures define what matters in the decision and become the criteria for evaluating alternatives

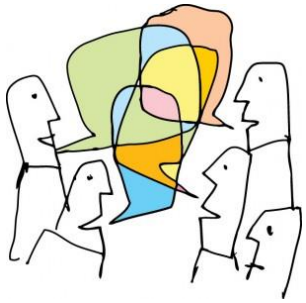


Assess “what matters”

….not what you have data on

“spiritual quality”

Assess “what matters”

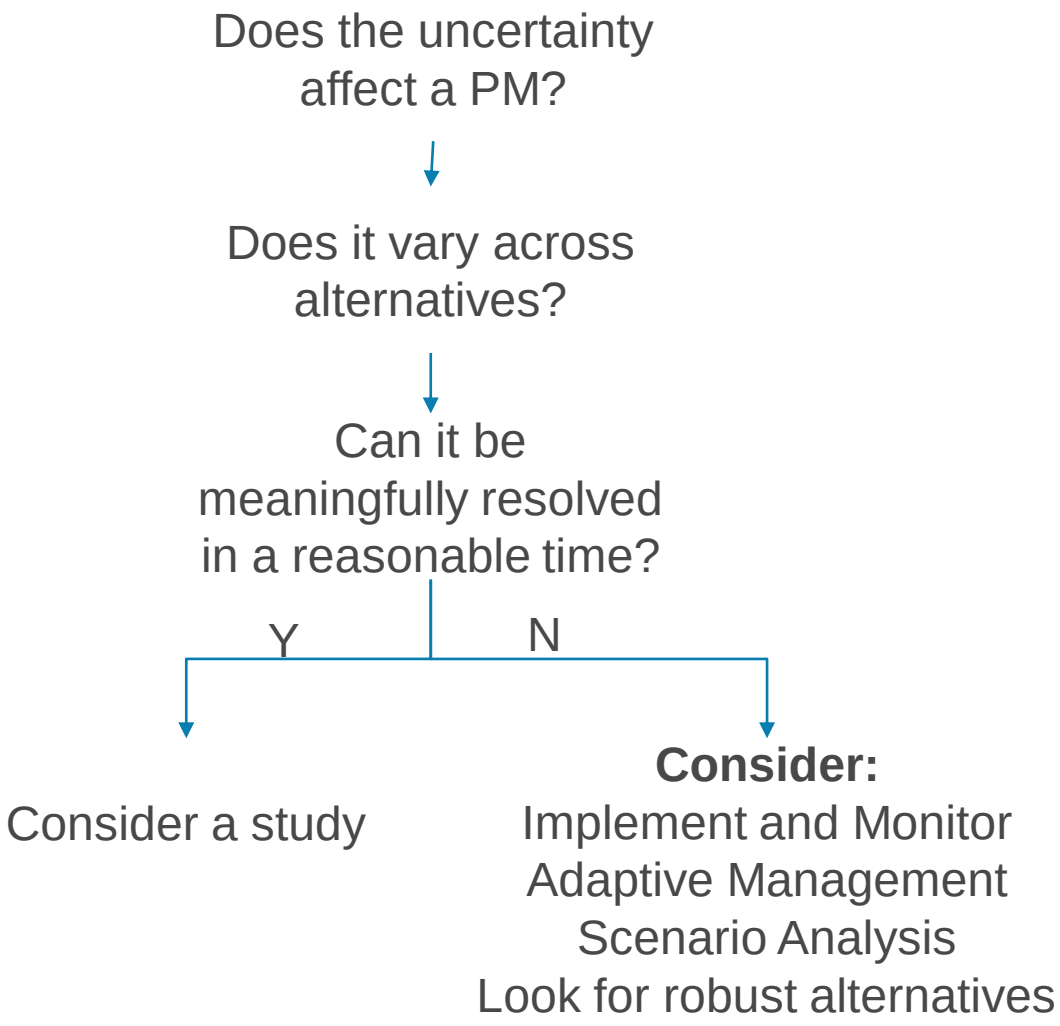


Objective	Sub-objective	Measure (units)
Salmon	All species	Biomass (kg)
	Chinook	Biomass (kg)
Species at Risk	Harlequin ducks	Abundance (#)
Riparian Health	Adult cottonwood	Growth Mm /year
	Juvenile cottonwood	Growth Mm/year
River Health	Benthic community abundance	Millions of individuals
	Benthic community diversity	% EPT
Spiritual Quality	Voice of the river	Scale (1-5)
Finances	Power revenues	$ million per year

Use Performance Measures to level the playing field…

- Across objectives
  - They operationalize hard-to-quantify objectives
- Across alternatives
  - Every alternative is evaluated on the same basis
- Across participants
  - Synthesize technical concerns for non-technical participants

Use Performance Measures to identify and prioritize studies…



Alternatives

What's the right number of alternatives?

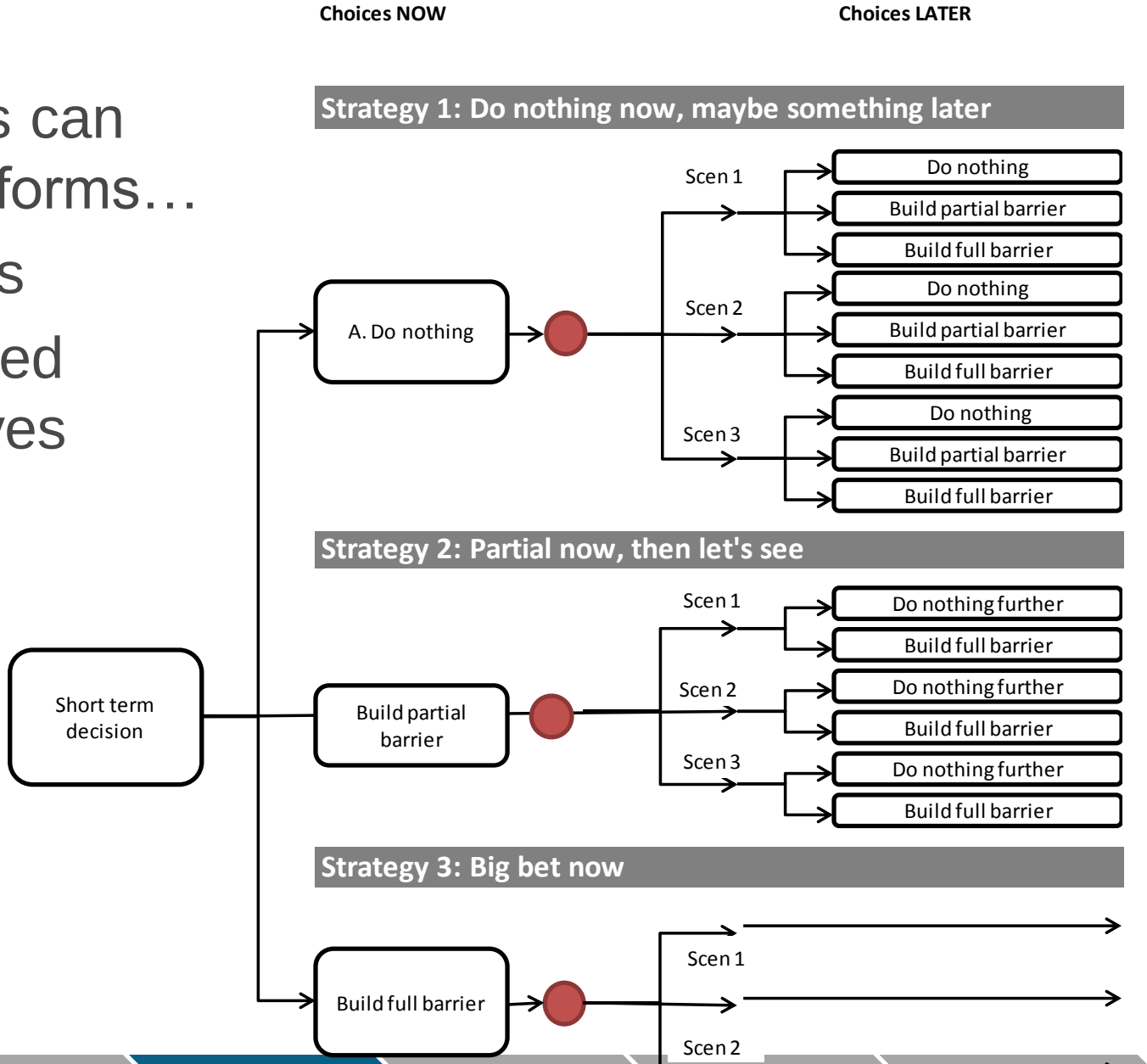
Generate a Range of Alternatives

- Develop a range of real, distinct and creative alternatives
- Iterate
- Don't panic!

People won't make tough trade-offs unless they're sure they have to… and that only happens if they believe the best alternatives are on the table

Alternatives can take many forms…

- Packages
- Sequenced alternatives



Make a Consequence Table

- Focus studies on populating the table
- Do analysis that is "good enough" to inform the decision
- Use models and expert judgment
- Iterate

		Alternatives				
Objective	**Attribute**	**E**	**F**	**G**	**H**	**I**
Upper Campbell						
Erosion	risk days per year	37	13	4	3	3
Recreation	rec days per year	43	40	106	158	158
Fish - Cutthroat	% Available Habitat	40	60	50	35	35
Lower Campbell						
Erosion	risk days per year	3	27	13	0	0
Recreation	rec days per year	115	43	83	167	170
Fish - Cutthroat	% Available Habitat	78	18	95	79	79
Fish - Rainbow	% Available Habitat	26	3	49	49	47
Campbell River						
Flooding	flood days per year	34	48	24	59	59
Recreation	rec days per year	66	83	51	81	79
Fish - Spill Risk	spill days per year	118	214	102	176	177
Fish - Spawning	% success	55	89	78	59	59
Fish - Rearing	risk indax	0.53	0.48	0.53	0.50	0.49
Salmon River						
Canoe Route	canoe days	162	167	153	204	183
Fish and Wildlife Habitat	habitat risk index	0.54	0.47	0.44	0.48	0.53
System-Wide						
Power	Annual Revenue M $ / Year	68.5	64.6	68.6	65.1	65.3

Get good at expert judgment

There are best practices… use them!

Use multiple experts

Separate facts and values

Avoid common biases

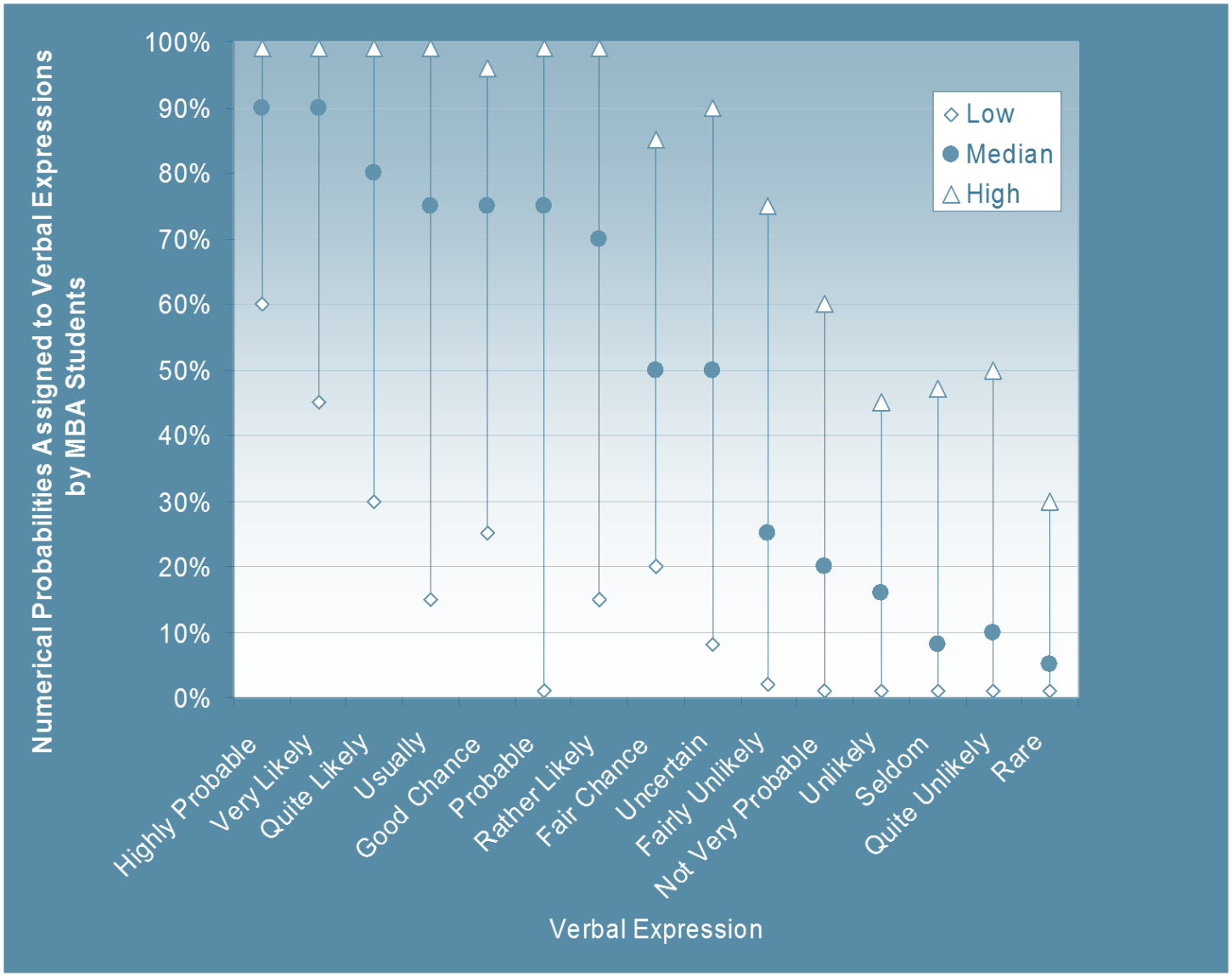
Avoid ambiguity

Use an appropriate elicitation protocol

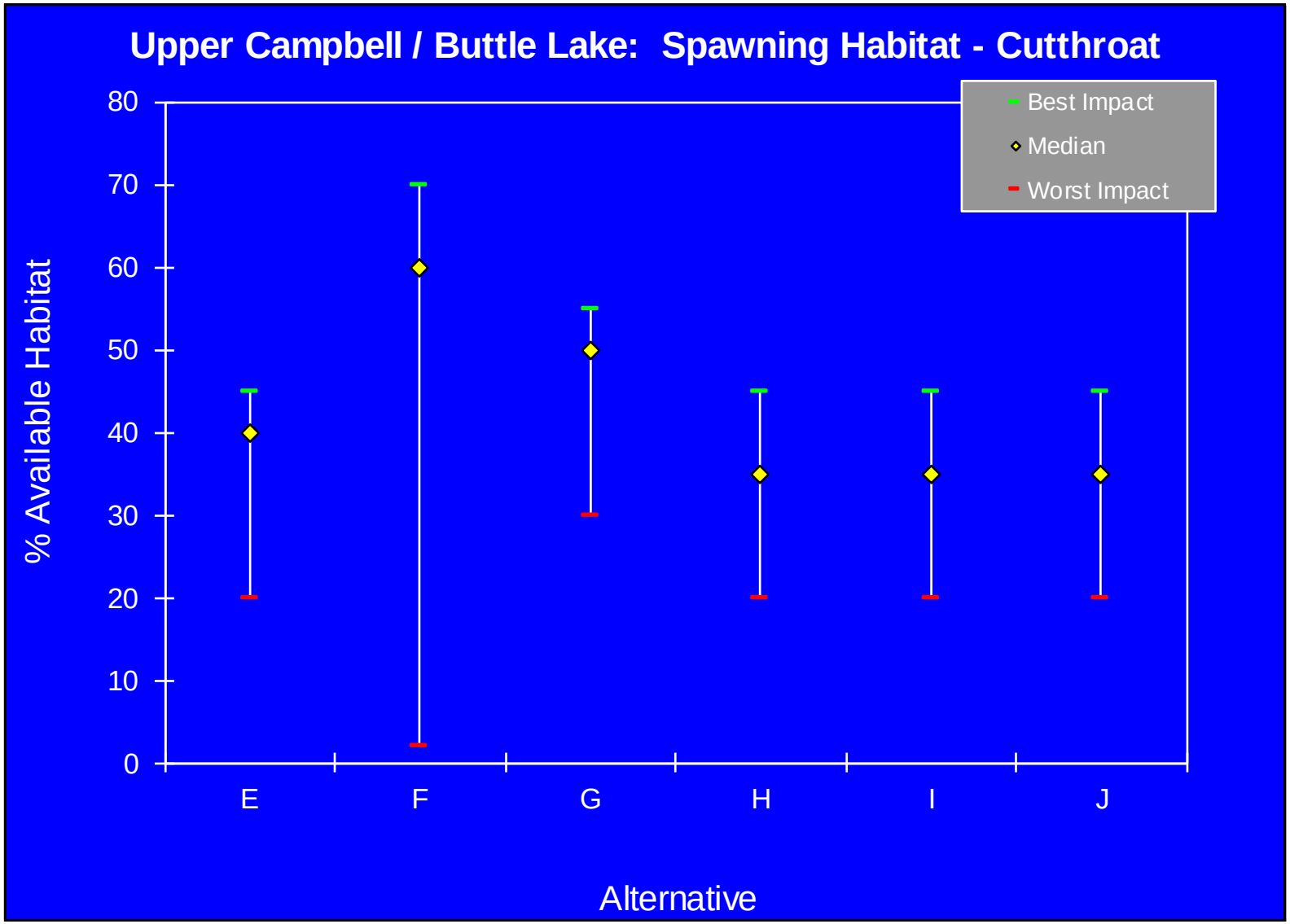
Compare across experts

Create a traceable account (peer reviewable!)

Be explicit about uncertainty



Address Risk Tolerance



Put the most relevant info in the CT

- Important but routine/repeated decisions
  - Expected value may be most relevant?
- Low probability high consequence events matter
  - Report both expected and extreme events?
- Low probability high consequence events can be ignored
  - 90% confidence interval?

You can't put all the uncertainty ranges in for all the performance measures

Focus on Trade-offs

(That’s another talk!)

Focus on Trade-offs

Simplify by eliminating dominated alternatives

Objective	Attribute	Alternatives E	F	G	H	I
Upper Campbell						
Erosion	risk days per year	37	13	4	3	3
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Focus on Trade-offs

- But suppose there are irreducible and complicated trade-offs?
- Use structured methods to facilitate useful dialogue and summarize differing views

INSTRUCTIONS

For each table:

A. Rank the measu

B. Assign 100 poir

C. Assign points to

Remember to assig
is very small or ver

s are okay.

from worst to best

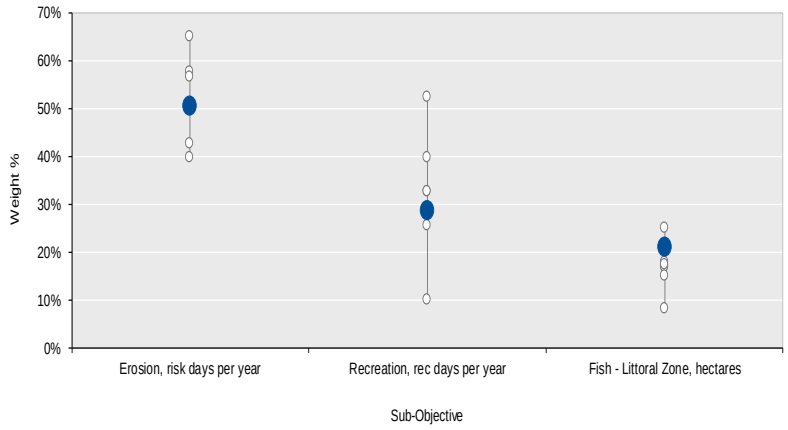


Table 1

Location					nk	Points (0 to 100)
Upper Campbell Lak						
	Recreation - Days / Yea	weighted days (217.5, 218.5, 200m by	40	158		
	Effective Littoral Zone	hectares	91	220		

Table 3

Location	Performance Measure	Units	Worst Case	Best Case	Rank	Points (from 0 to
Campbell River	Flooding - Total Days	weighted days (300, 453, 530 cms)	59	24		
	Recreation - Days / Yea	weighted days (28 cms - 80 cms)	51	83		
	Spawning Habitat - All S	% successful redds (Chum as indicato	55	89		
	Rearing Habitat - All Sp	"Average" risk index (scale 0 - 1)	0.53	0.48		

Monitoring and Adaptive Management

Final Operating Alternatives

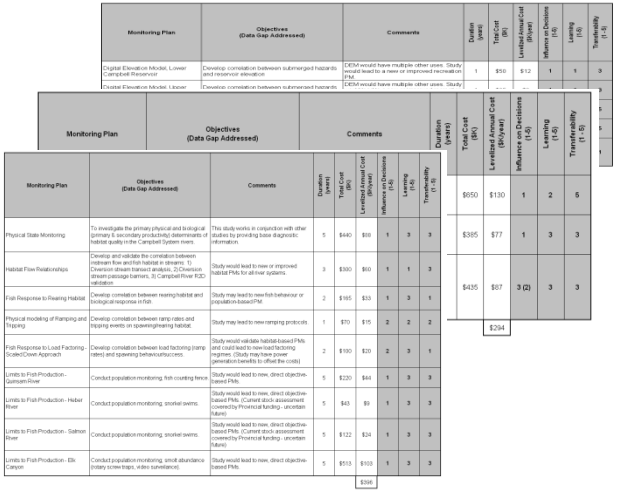
Consequence Table November 2002 - CORE OPERATING STRATEGY DECISION

Location	Performance Measures (1)	Units	What's Good	Significant Difference	Alternatives REF	R15 Heber	S15 Heber
Upper Campbell / Buttle Lake							
	Erosion - Days / Year	weighted days	less	10%	16	4	4
	Recreation - Days / Year	weighted days	more	10%	50	92	85
	Effective Littoral Zone	hectares	more	10%	80	94	92
	Spawning Habitat - Cutthroat	% Available Habitat	more	10%	6	10	10
	Spawning Habitat - Rainbow	% Available Habitat	more	10%	3	5	5
Lower Campbell / McIvor / Fry							
	Erosion - Days / Year	weighted days (2)	less	10%	11	11	10
	Recreation - Days / Year	weighted days (2)	more	10%	102	95	98
	Elevation Variability	Coefficient of Variation	less	10%	0.08	0.16	0.09
	Effective Littoral Zone	hectares	more	10%	86	82	83
	Spawning Habitat - Cutthroat	% Available Habitat	more	10%	4	3	2
	Spawning Habitat - Rainbow	% Available Habitat	more	10%	25	31	15 (22)
Campbell River							
	Flooding - Total Days	weighted days	less	10%	27	18	20
	Recreation - Days / Year	weighted days	more	10%	79	60	60
	Total Spill Days - All Species	total days	less	10%	160	111	114
	Spawning Habitat - All Species	% successful redds (Chum)	more	10%	69	71	69
	Rearing Habitat - All Species	"Average" risk index (0 - 1)	less	10%	0.54	0.59	0.58
	Elk Canyon	FTC judgement	more	0%	O	++++	++++
Salmon River							
	Canoe Route Safety	Flow Rating	more		O	O	O
	All Habitat - All Species	"Average" risk index (0 - 1)	less	10%	0.54	0.46	0.46
	Fish Screen Performance	Fishing Efficiency, Fish Condition	more		O	O	O
System-Wide							
	Power / Financial	Annual Revenue M $ / Year	more	1%	66.9	68.2	68.3
		Cost: Salmon Fish Screen (M $ / Year)	less	1%	0	0	0
		Cost: All Other Physical Works (M $ / Year)	less	1%	-0.10	-0.10	-0.10
		Cost: Monitoring (M $ / Year)	less	1%	-0.70	-0.70	-0.70
	GHG	Equivalent Mtonnes CO2/Year	less	1%	-600	-614	-616
	Diversions	Status of Heber Diversion (3)			Status Quo	Heber decision	Heber decision

Relative to REF: Better / Neutral / Worse

Notes: 1) All PM results are median values over 37 years, except for ELZ and Annual Revenue (average over 37 years), Flooding and Fish Spills (total days over 37 years), and Physical Works Costs (levelized costs as described in proposals).
2) Adjustments were made to account for these PM's sensitivity to the 177.4 vs. 177.5 summertime maximum target elevation.
3) It has previously been decided to continue operation of the Salmon and Quinsam diversions.

Monitoring Programs



Monitoring Plan	Objectives (Data Gap Addressed)	Comments	Duration (years)	Total Cost ($K)	Levelized Annual Cost ($K/year)	Influence on Decisions (1-5)	Learning (1-5)	Transferability (1 - 5)
Digital Elevation Model, Lower Campbell Reservoir	Develop correlation between submerged hazards and reservoir elevation	DEM would have multiple other uses. Study would lead to a new or improved recreation PM.	1	$50	$12	1	1	3
Digital Elevation Model, Upper	Develop correlation between submerged hazards	DEM would have multiple other uses. Study						
Physical State Monitoring	To investigate the primary physical and biological (primary & secondary productivity) determinants of habitat quality in the Campbell System rivers	This study works in conjuction with other studies by providing base diagnostic information.	5	$440	$88	1	3	3
Habitat Flow Relationships	Develop and validate the correlation between instream flow and fish habitat in streams: 1) Diversion stream transect analysis, 2)Diversion stream passage barriers, 3) Campbell River R2D validation	Study would lead to new or improved habitat PMs for all river systems.	3	$360	$60	1	1	3
Fish Response to Rearing Habitat	Develop correlation between rearing habitat and biological response in fish.	Study may lead to new fish behaviour or population-based PM.	2	$165	$33	1	3	1
Physical modeling of Ramping and Tripping	Develop correlation between ramp rates and tripping events on spawning/rearing habitat.	Study may lead to new ramping protocols	1	$70	$15	2	2	2
Fish Response to Load Factoring - Scaled Down Approach	Develop correlation between load factoring (ramp rates) and spawning behaviour/success.	Study would validate habitat-based PMs and could lead to new load factoring regimes. (Study may have power generation benefits to offset the costs)	2	$190	$20	2	3	1
Limits to Fish Production - Quinsam River	Conduct population monitoring: fish counting fence	Study would lead to new, direct objective-based PMs.	5	$220	$44	1	3	3
Limits to Fish Production - Heber River	Conduct population monitoring: snorkel swims.	Study would lead to new, direct objective-based PMs. (Current stock assessment covered by Provincial funding - uncertain future)	5	$45	$9	1	3	3
Limits to Fish Production - Salmon River	Conduct population monitoring: snorkel swims.	Study would lead to new, direct objective-based PMs. (Current stock assessment covered by Provincial funding - uncertain future)	5	$122	$24	1	3	3
Limits to Fish Production - Elk Canyon	Conduct population monitoring: smolt abundance (rotary screw-traps, video surveillance).	Study would lead to new, direct objective-based PMs.	5	$513	$103	1	3	3
					$396			
				$650	$130	1	2	5
				$385	$77	1	3	3
				$435	$87	3 (2)	3	3
					$294			

Key Messages

- Sketch the decision before you start – it will change the focus of analysis
- Level the playing field – using performance measures let's non-technical people participate on equal footing
- Generate alternatives – solutions are only as good as the alternatives explored, and science has a role to play
- Focus your analysis on the evaluation of alternatives
- Compare the risk profiles of alternatives – let decision makers express their risk tolerane
- All choices involve tough trade-offs; there are ways to help groups address them productively
- Agreement in the presence of uncertainty is likely to require a firm commitment to monitoring and adaptive management

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THANKS!