Risk-Informed Decision Framework for Setting Environmental Windows for Dredging Projects

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Problems with Setting Environmental Windows

- EW: Time periods that allow the dredging; seasonal restriction is opposite meaning, that is those activities are prohibited.
- No consistent, broadly accepted methodology for objectively setting EWs has emerged
- Some case, EWs are set without scientific basis (NRC 2001) and established by negotiations emphasizing conservative professional judgments

Problems with Setting Environmental Windows

- Most of allowable EWs are not flexible and do not consider:
  - ► consequences of contractual delays
  - ► availability of dredge plants,
  - ► safety issues risks to dredge crew (e.g., safety during cold weather periods)
- This results in higher costs for Federal projects: are the benefits worth these costs?
- How to balance the various factors of importance?

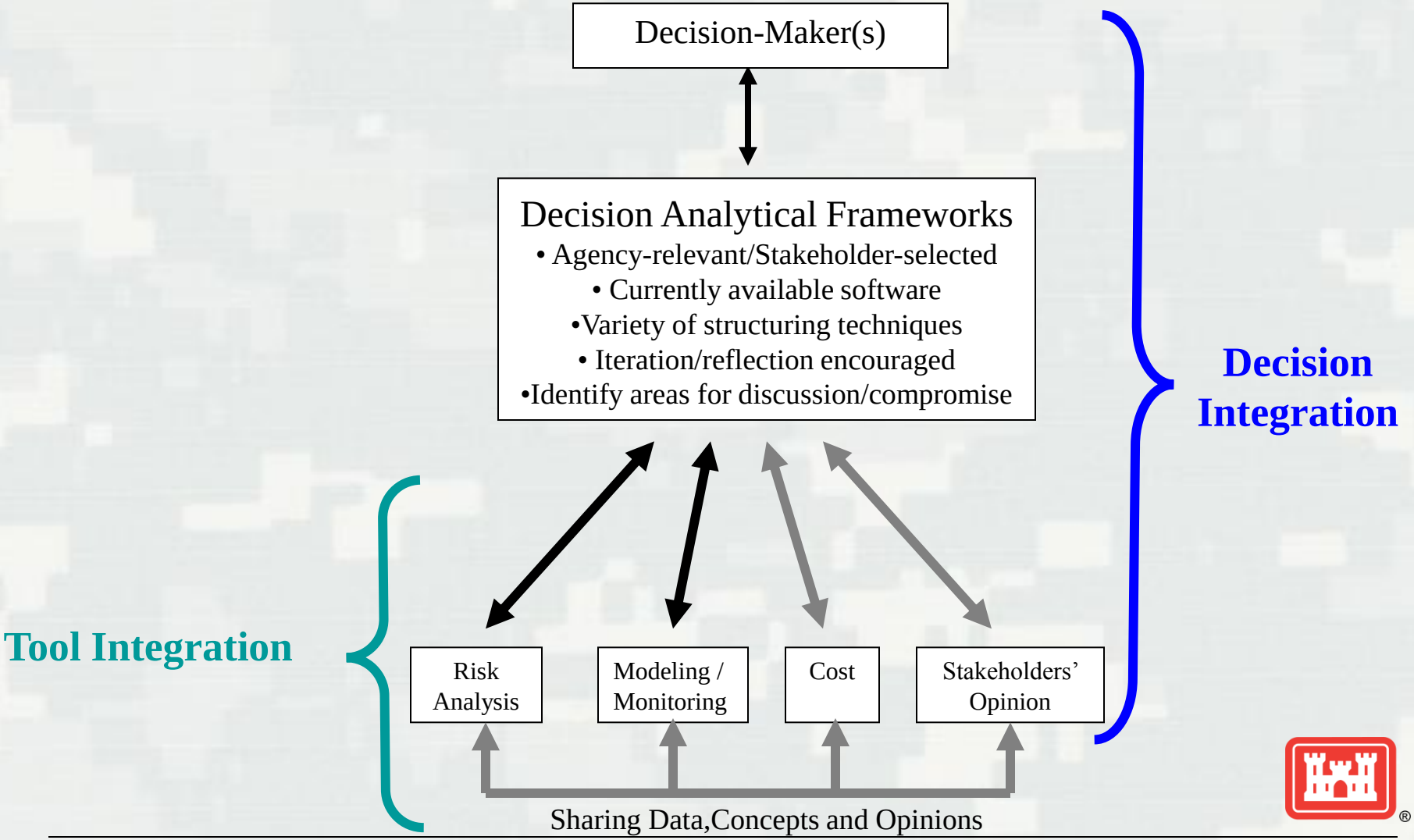
Problems with Setting Environmental Windows

- According to NRC (2001):

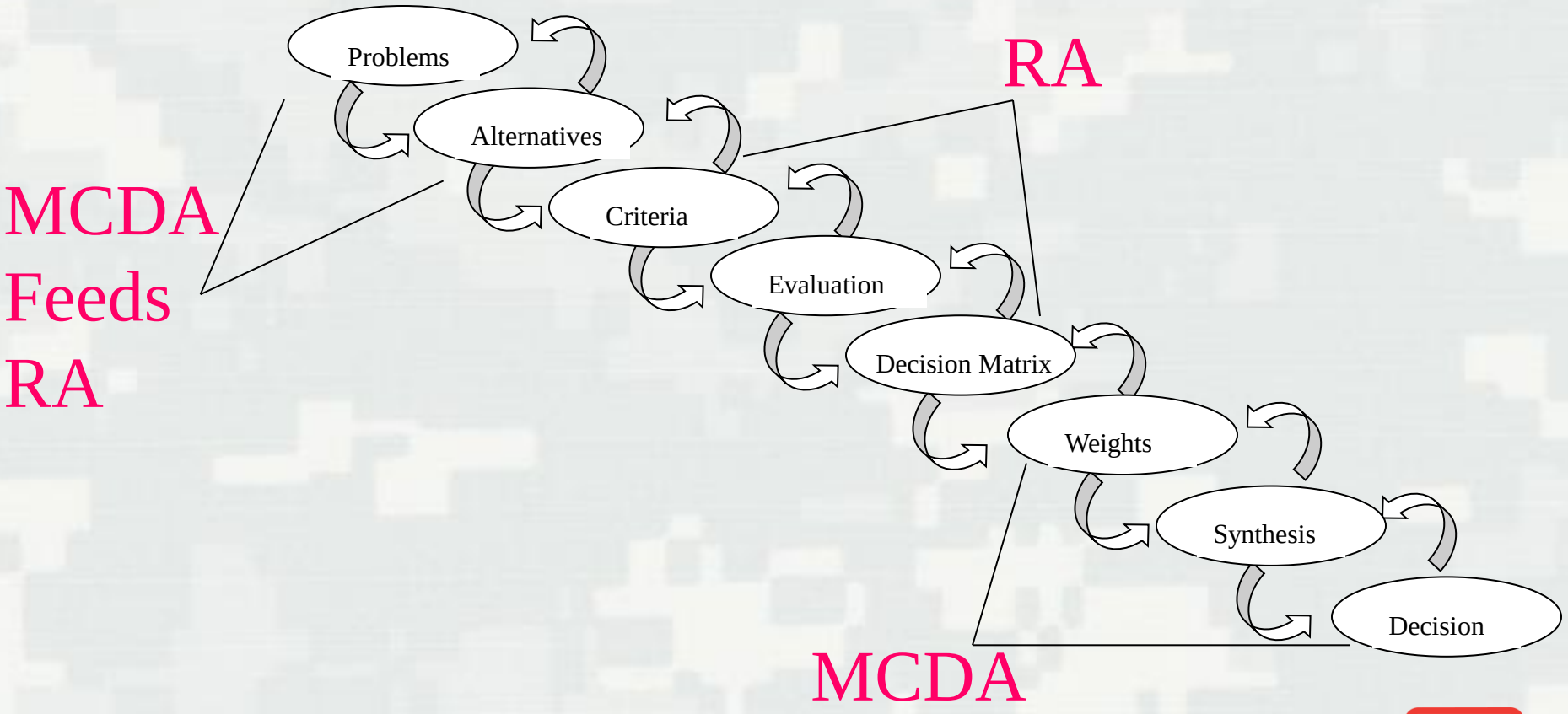
  "a special effort should be made to identify existing tools for structured decision making in complex socio-political situations and to evaluate their applicability to the process of setting environmental windows for dredging…, its implementation will be challenging because it calls for a balancing of priorities…it is also the most critical

- None have applied a structured decision process that can systematically evaluate various EW alternatives in terms of their comparative risks

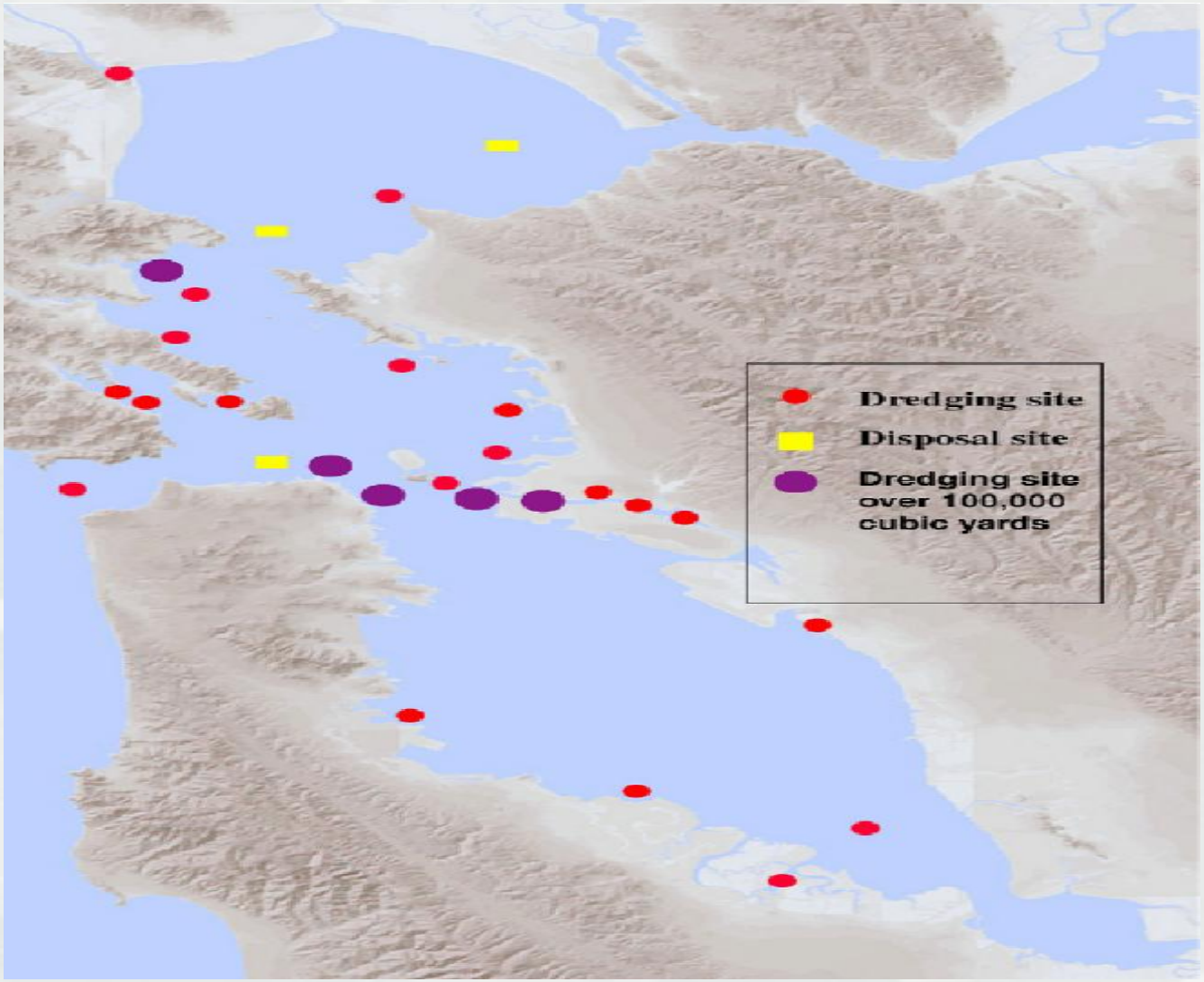
Evolving Decision-Making Processes



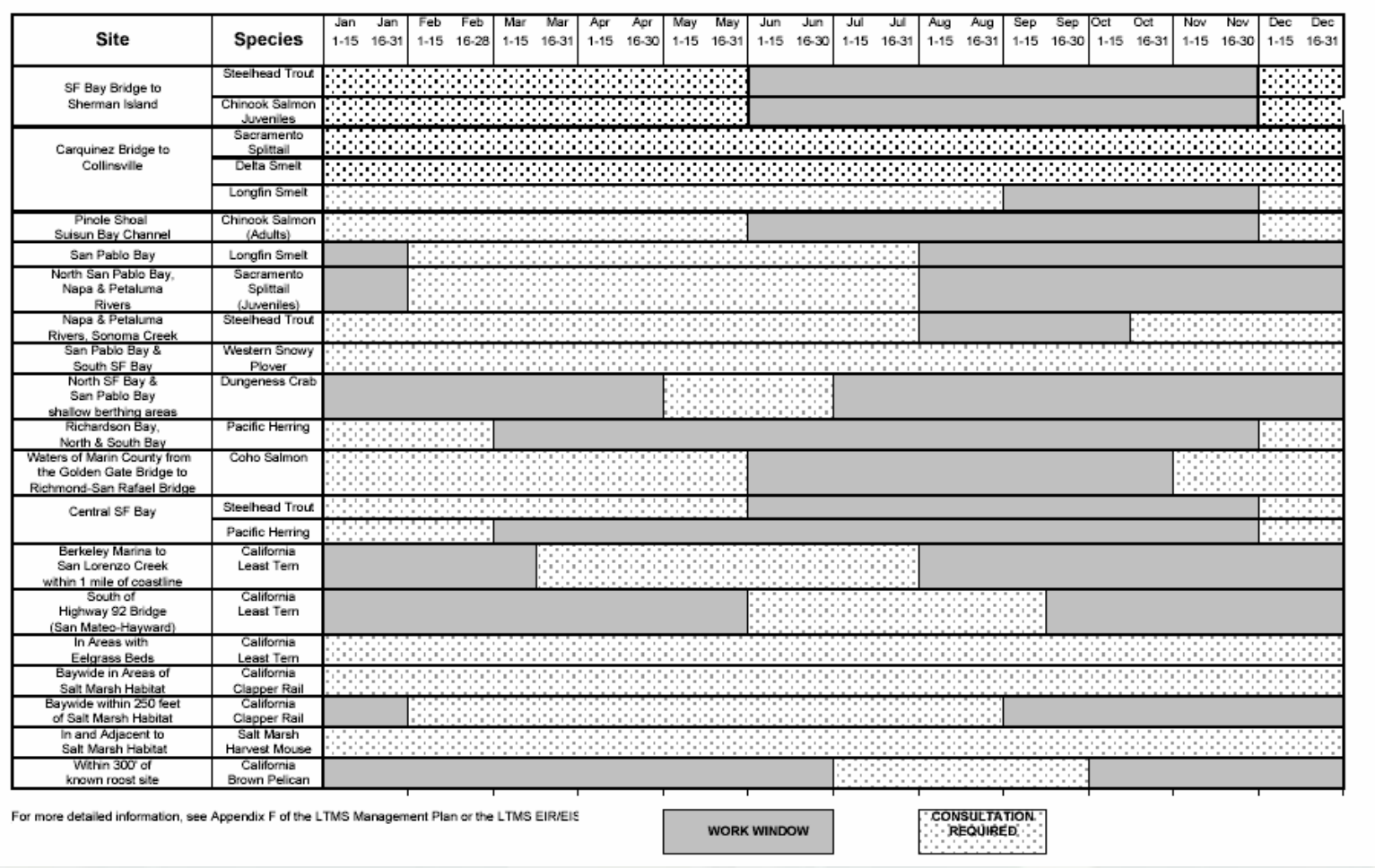
Environmental Windows as Decision Problem



Dredging: Environmental Impacts



EW: Management Alternative to Minimize Impact



Site	Species	Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	Jun 1-15	Jun 16-30	Jul 1-15	Jul 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-30	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31
SF Bay Bridge to Sherman Island	Steelhead Trout																								
	Chinook Salmon Juveniles																								
Carquinez Bridge to Collinsville	Sacramento Splittail																								
	Delta Smelt																								
	Longfin Smelt																								
Pinole Shoal Suisun Bay Channel	Chinook Salmon (Adults)																								
San Pablo Bay	Longfin Smelt																								
North San Pablo Bay, Napa & Petaluma Rivers	Sacramento Splittail (Juveniles)																								
Napa & Petaluma Rivers, Sonoma Creek	Steelhead Trout																								
San Pablo Bay & South SF Bay	Western Snowy Plover																								
North SF Bay & San Pablo Bay shallow berthing areas	Dungeness Crab																								
Richardson Bay, North & South Bay	Pacific Herring																								
Waters of Marin County from the Golden Gate Bridge to Richmond-San Rafael Bridge	Coho Salmon																								
Central SF Bay	Steelhead Trout																								
	Pacific Herring																								
Berkeley Marina to San Lorenzo Creek within 1 mile of coastline	California Least Tern																								
South of Highway 92 Bridge (San Mateo-Hayward)	California Least Tern																								
In Areas with Eelgrass Beds	California Least Tern																								
Baywide in Areas of Salt Marsh Habitat	California Clapper Rail																								
Baywide within 250 feet of Salt Marsh Habitat	California Clapper Rail																								
In and Adjacent to Salt Marsh Habitat	Salt Marsh Harvest Mouse																								
Within 300' of known roost site	California Brown Pelican																								

For more detailed information, see Appendix F of the LTMS Management Plan or the LTMS EIR/EIS

WORK WINDOW

CONSULTATION REQUIRED

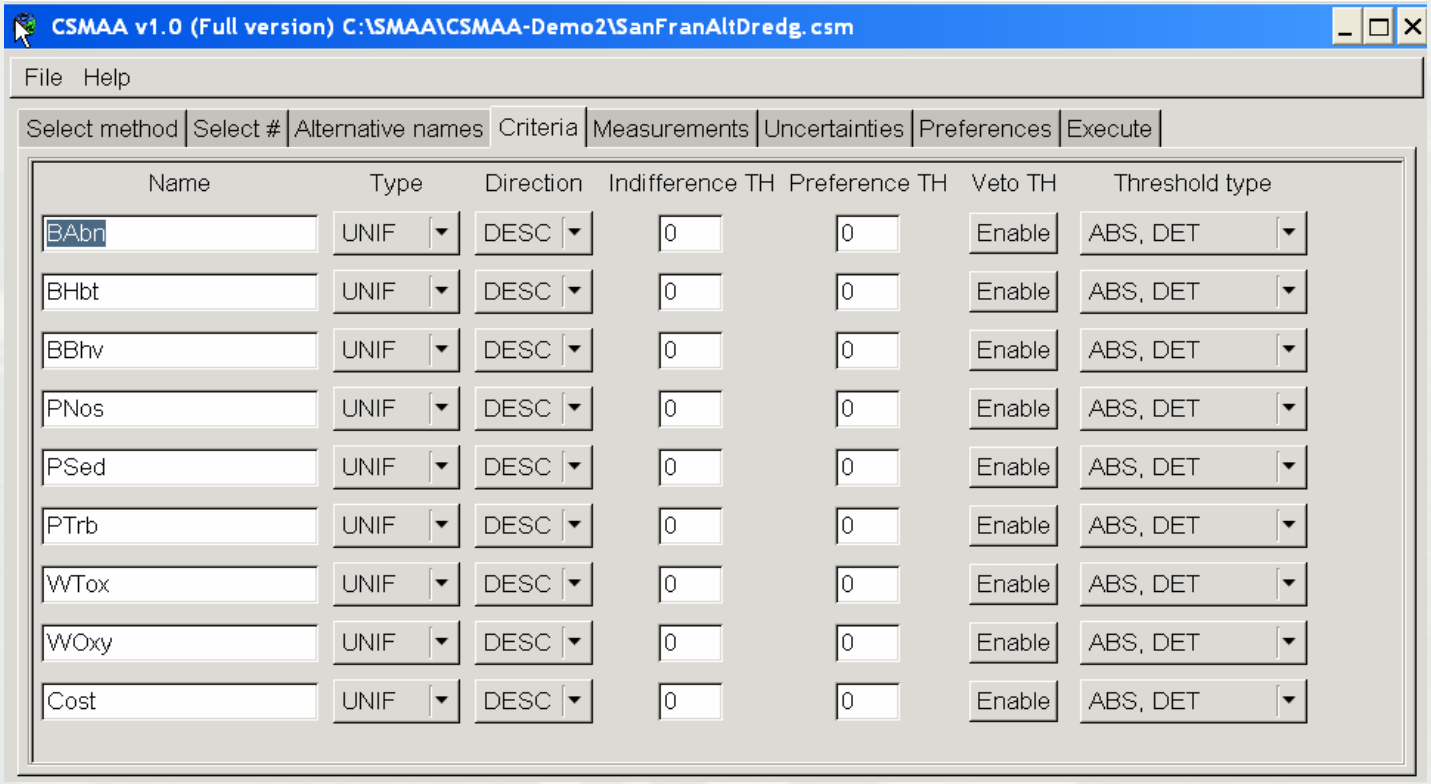
Example:
Pacific Herring in San Francisco Bay

- ~3000 tons of roe harvested each year
- Herring spawn in proximity to areas that are periodically maintained by dredging, which fosters concern that dredging activities could harm the species or the fishery
- The EW for herring extends from March through November
  - ► Dredging in December-February requires consultation with the appropriate regulatory agencies. Our hypothetical example considers extending the environmental window into the month of December

Alternatives

- Hydraulic and mechanical dredging in November, December and January (HNov, MNov, HDec, MDec, HJan, MJan)

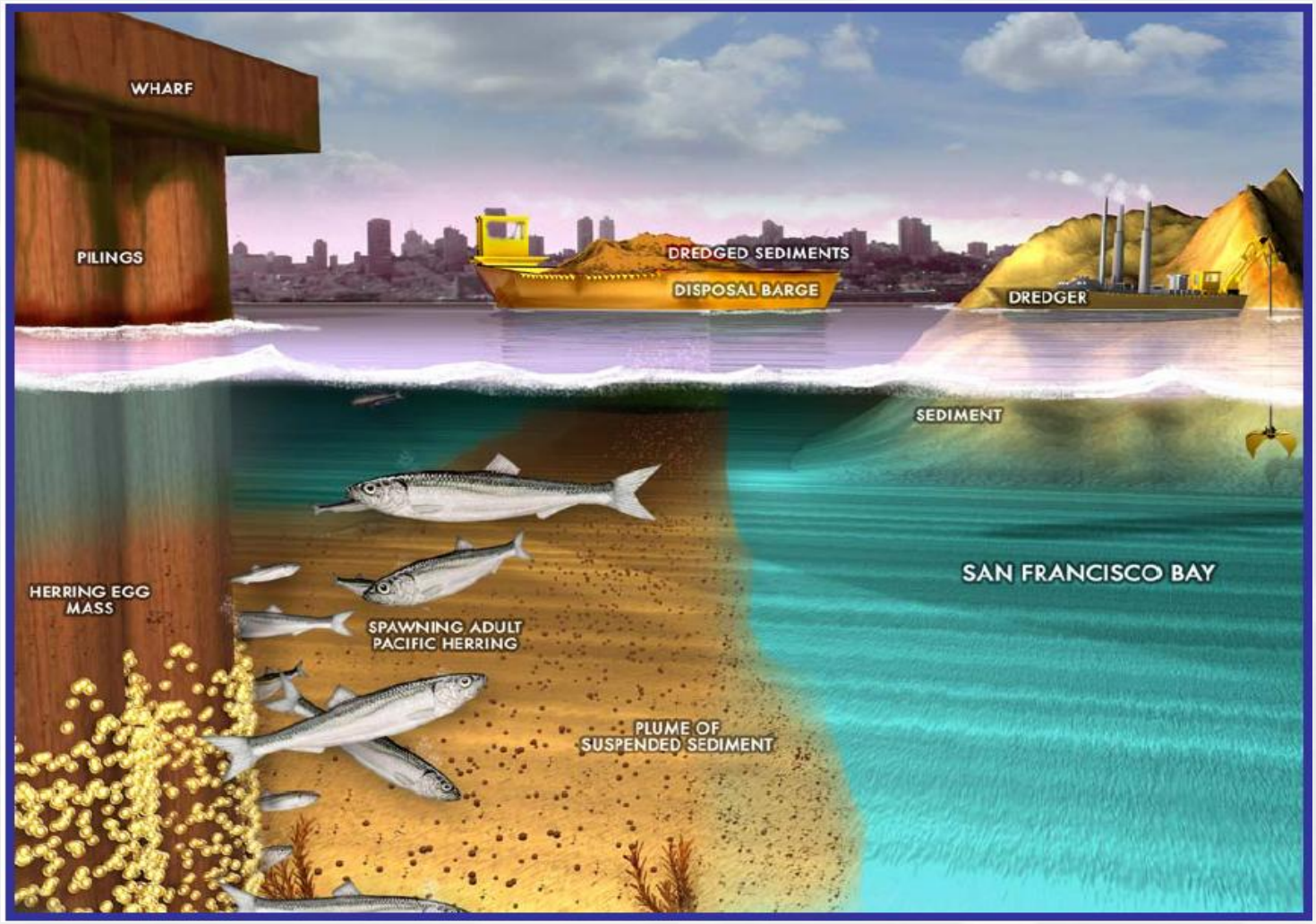
Assessment Criteria



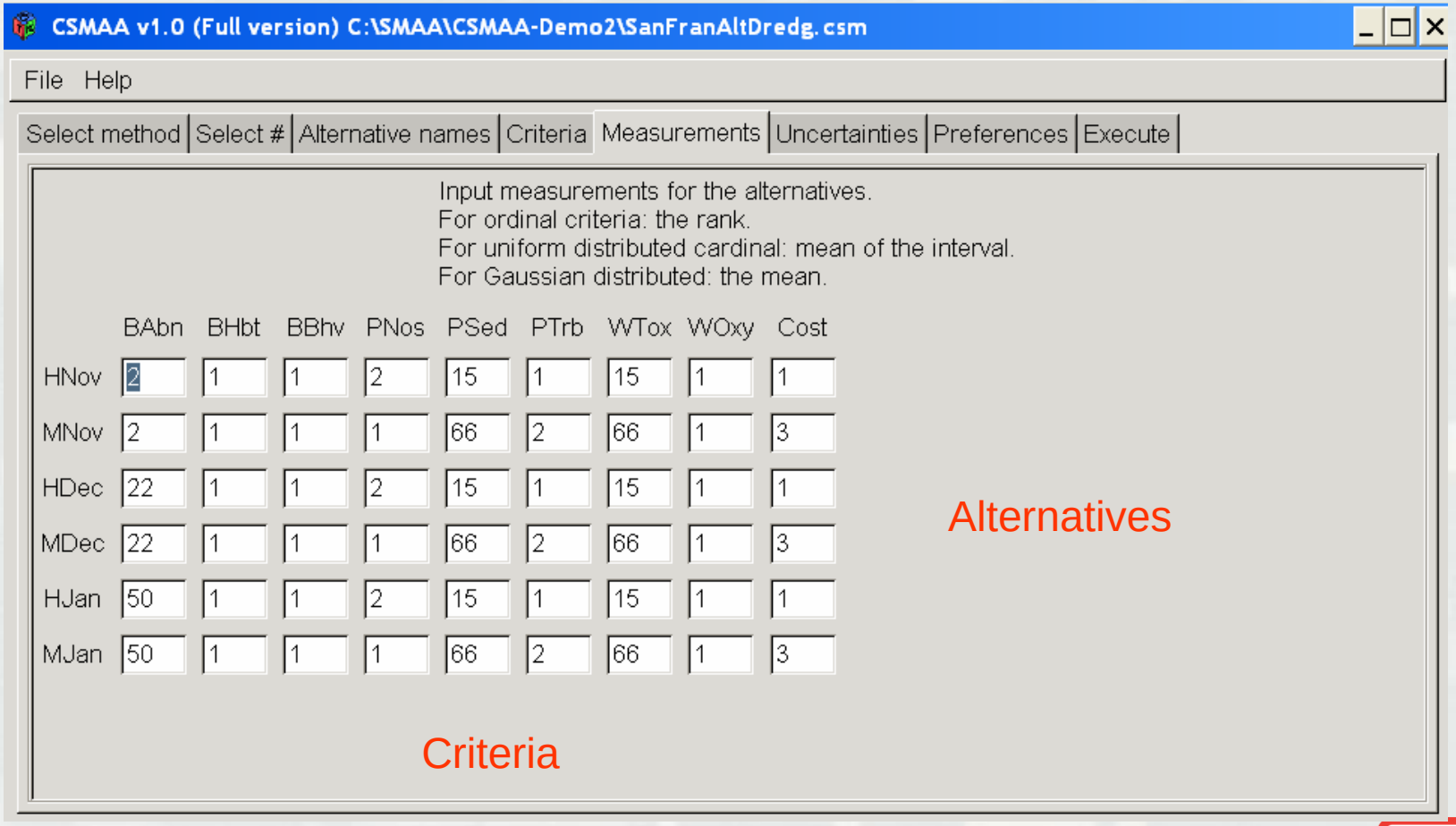
Name	Type	Direction	Indifference TH	Preference TH	Veto TH	Threshold type
BAbn	UNIF	DESC	0	0	Enable	ABS, DET
BHbt	UNIF	DESC	0	0	Enable	ABS, DET
BBhv	UNIF	DESC	0	0	Enable	ABS, DET
PNos	UNIF	DESC	0	0	Enable	ABS, DET
PSed	UNIF	DESC	0	0	Enable	ABS, DET
PTrb	UNIF	DESC	0	0	Enable	ABS, DET
WTox	UNIF	DESC	0	0	Enable	ABS, DET
WOxy	UNIF	DESC	0	0	Enable	ABS, DET
Cost	UNIF	DESC	0	0	Enable	ABS, DET

Biological: Abundance (BAbn), Impact on Habitat (BHbt), and Impact on spawning behavior (BBhv)
Physical: Suspended Sediments (Psed) and Noise (PNos)
Water Quality: Contamination, (WTox) and Oxygen Reduction (WOxy)
Economic - Cost

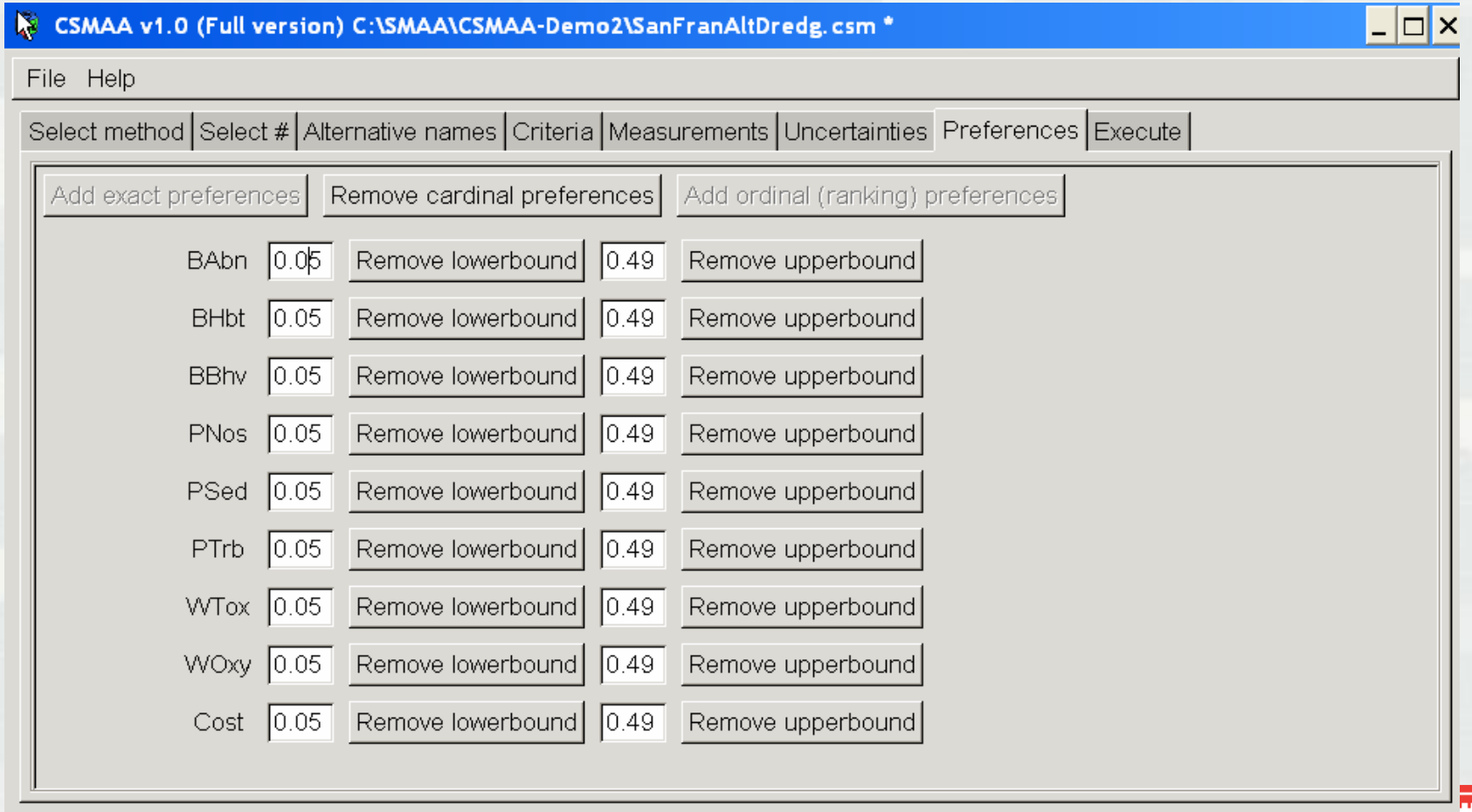
Conceptual Model of Sediment Impact on Herring



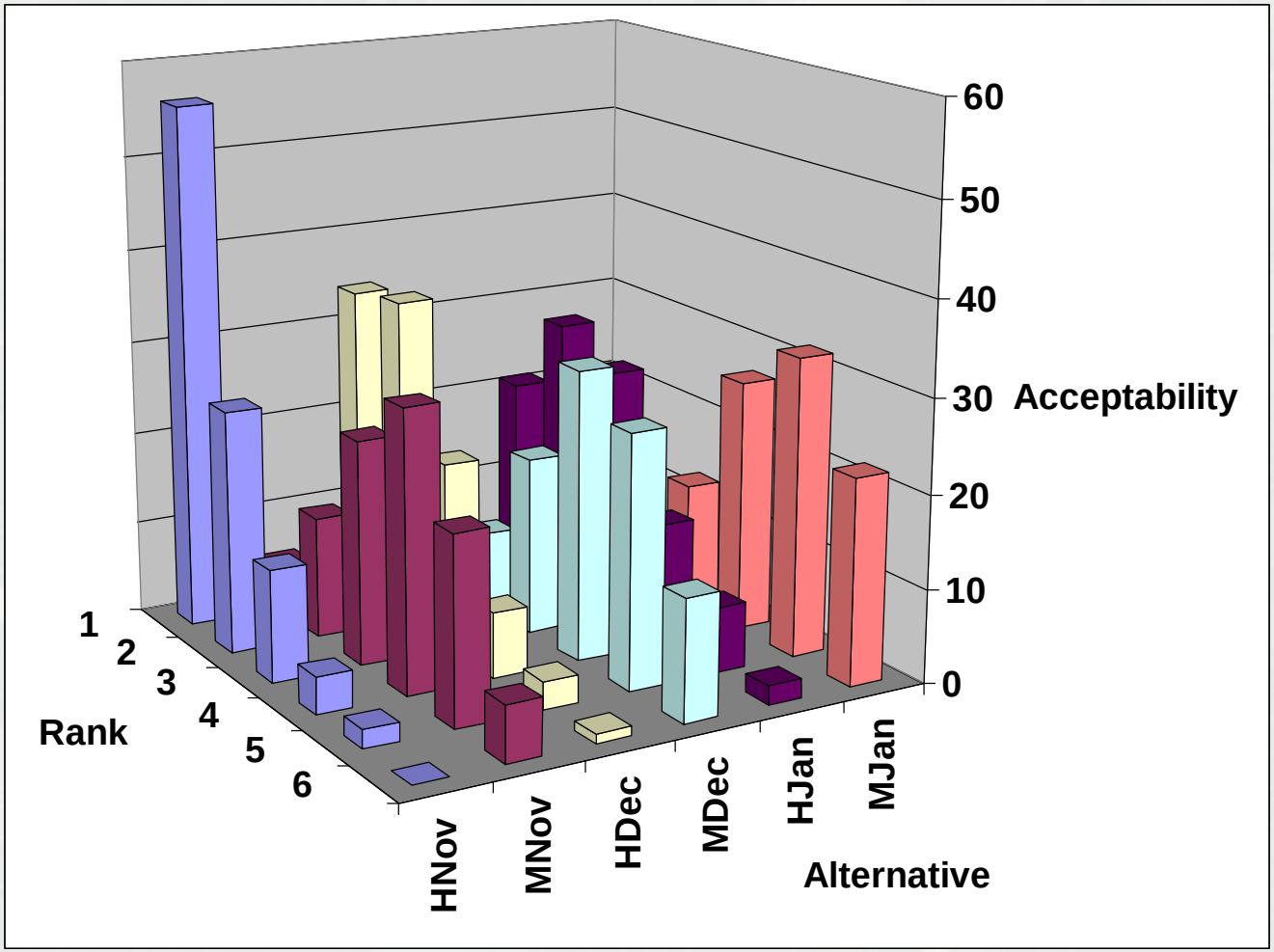
Metric Assessment by Criteria



Criteria Weight



Rank Acceptability Analysis

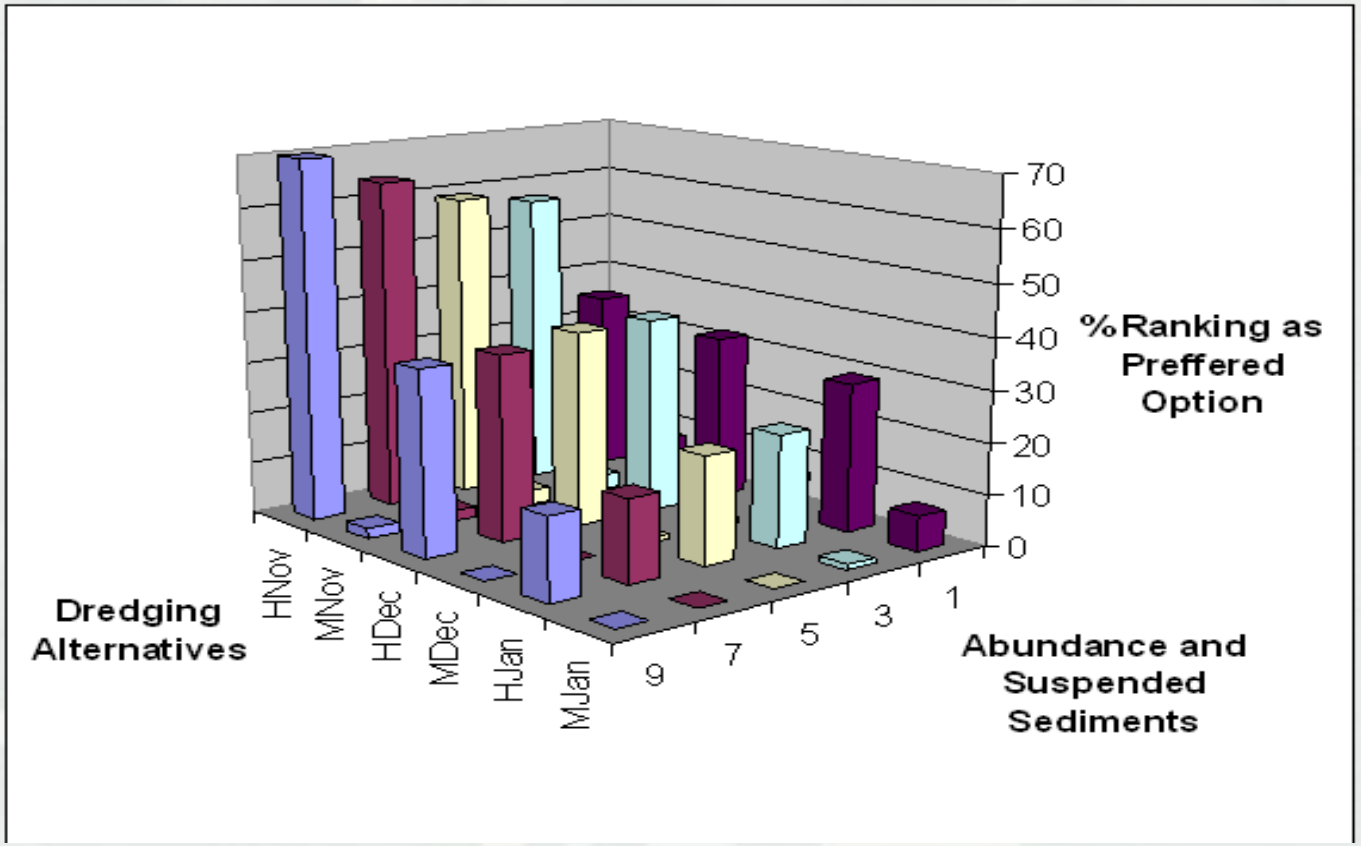


Pair-wise Metrics Domination Matrix

	HNov	MNov	HDec	MDec	HJan	MJan
HNov	0	86	78	98	96	100
MNov	9	0	30	77	68	95
HDec	13	63	0	87	83	98
MDec	1	18	9	0	37	77
HJan	3	26	11	53	0	84
MJan	0	4	1	13	11	0

- Dark green: 50-100%
- Light green is 25-49%
- Red is less than 25% of cases outranked by other alternatives.

Sensitivity Analysis



- Varying weights for one biological (BAbn) and one physical criterion (PSed) while all other criteria were equally ranked.

Main Points

- Risks and benefits associated with alternative resuspension management can be quantified using risk informed decision making
- Model, Parameter and Scenario uncertainty and variability associated with predicting efficiency of dredging alternatives as well as stakeholder value judgment are important to consider
- Challenges of risk assessment and planning for situations with a limited knowledge base and high uncertainty and variability require coupling traditional risk assessment and planning with multi-criteria decision analysis (MCDA) to support dredging decisions