A Role for Decision Science in Puget Sound Recovery

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Highlights

1. As decisions become more complicated, we need tools to help structure our thinking.
2. Structured decision making, an approach to improving decisions, has been applied for some two decades to regional scale environmental management problems in Canada, the U.S., and further abroad, reporting many interesting and successful cases.
3. In March 2012, the Puget Sound Partnership's Science Panel and staff developed a decision analytical tool to model and rank sub-strategies in the 2012 Action Agenda. Sub-strategies help lay out the agency's biennially chosen priorities for Puget Sound recovery and protection.
4. In 2014 the Partnership also used decision science to develop a prioritization process that could meet the needs of Local Integrating Organizations to choose near term actions as part of the Action Agenda process.
5. Decision science could fulfill additional roles. For example, it offers techniques for prioritizing research efforts to reduce scientific uncertainties (as in current Puget Sound Ecosystem Monitoring Program and Biennial Science Work Plan efforts) and developing implementation strategies for achieving Puget Sound Vital Signs.

Introduction

We've all heard of "hitting the jackpot" and "hindsight is 20-20." But good decision making is not about getting a lucky break or concluding that we made the "right" decision once uncertainties have broken in our favor. The quality of the decision-making process is fundamental. Over the last three years, the Puget Sound Partnership has invested in decision science expertise in its ongoing role of supporting effective Puget Sound recovery. This paper describes some of these efforts and analyzes several decision support ideals.

Some Decision Support Ideals

What might successful decision support at the Puget Sound Partnership look like? For 50 years[1], the field of decision analysis, which emerged from operations research and decision theory, has studied and developed rigorous and practical methods of improving how we make decisions. Two dominant themes are highlighted here.

First, a good decision-making process will urge the decision maker to be more explicit about his or her assumptions, values, perspectives, and limits of knowledge. One reason this is done is so that sources of logical inconsistency in thinking can be detected and addressed. As decisions become more complicated, we need tools to help structure our thinking. When planning a small outdoor party, it may be simple common sense to plan for the possibility of rain by spending some resources to buy alternative indoor entertainment. But what about developing a plan to protect an endangered species, or deciding on whether to issue a permit for a project that may threaten sensitive environmental habitats? In these harder decisions, decision analysis offers qualitative and quantitative approaches to

[1] http://meetings2.informs.org/sanfrancisco2014/gala.html

synthesize the opinions of differing experts, estimate the value of new information, or represent outcome uncertainty and differing attitudes toward risk—seeking to bring all judgments and information together into a coherent whole.

Second, good decision making leads to a model or process that is accepted by the user as providing useful guidance and insight toward action. At some point the drive toward rationality expressed by the first principle is balanced by the decision-maker's confidence that the model or process has addressed all that it needs to address. The model or process should include, at minimum, the following:

- A useful set of objectives and associated measures to assess progress;
- A creative and diverse range of alternatives to pursue the objectives;
- The use of considerable modeling, data collection, and expert judgment to characterize the relative performance of the alternatives in ways understandable to the participants;
- Explicit consideration of tradeoffs and rationales for choosing certain alternatives over others.

When the decision problem is unfamiliar, it will also require opportunities to learn and potentially revise initial judgments about one's preferences for different outcomes and about what is believed to be most likely to result from an action.

I believe that decision analysis can enhance environmental protection and restoration in Puget Sound. Structured decision making—an approach to decision analysis emphasizing the social and political needs of public planning efforts—has been applied for some two decades to regional scale environmental management problems in Canada, the U.S., and further abroad, reporting many interesting and successful cases[2]. Training in structured decision making is available through U.S. federal agencies such as the Fish and Wildlife Service[3], and the Department of the Interior has framed its adaptive management guidance within a structured decision making context[4]. Descriptions of many successful environmental applications of decision analysis are available in the literature[5, 6], as are descriptions of available support software[7].

Decision Science for Puget Sound Recovery: Off to a Good Start

In March 2012, the Puget Sound Partnership's Science Panel and staff developed a decision analytical tool to rank sub-strategies in the 2012 Action Agenda[8]. Organized hierarchically, strategies, sub-

[2] Gregory, R., L. Failing, M. Harstone, G. Long, T. McDaniels, D. Ohlson. 2012. Structured decision making: A practical guide to environmental management choices. Wiley-Blackwell, 299 pp.
[3] http://nctc.fws.gov, search on "structured decision".
[4] Williams, B. K., R.C. Szaro, and C.D. Shapiro. 2007. Adaptive Management: The U.S. Department of Interior Technical Guide, US Department of Interior, Washington D.C.
http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf
[5] Huang, I., J. Keisler, I. Linkov. 2011. Multi-criteria decision analysis in environmental sciences: Ten years of applications and trends. Science of the Total Environment 409(19): 3578-3594.
[6] Hobbs, B., P. Meier. 2000. Energy decisions and the environment: A guide to the use of multicriteria methods. Kluwer Academic, 257 pp.
[7] http://viewer.zmags.com/publication/b9b8a138#/b9b8a138/62
[8] http://www.psp.wa.gov/action_agenda_2012-13.php

strategies, and near term actions lay out the agency's biennially chosen priorities for Puget Sound recovery and protection. Sub-strategies fall at a level of detail intermediate between more general strategies and more detailed near term actions. The preliminary result of this effort was a list of sub-strategies modeled and ranked based on their expected ecological impacts. This is preliminary since the true breadth of objectives that motivate the choice of Action Agenda priorities would at least include funding status, economic costs, human well-being, and implementability considerations. In addition, sub-strategies were viewed as too general to gain sufficient clarity on the expected outcomes, and participants were reluctant to consider tradeoffs (and thus prioritize) across different ecosystem domains (e.g., across water quality, ecology, and land use). Still, participants responded positively to the exercise and subsequent work is planned.

Some challenges to continuing this work will go beyond merely knowing what to do (e.g., expanding the set of objectives, considering tradeoffs). They will require successfully organizing and guiding the participants in the decision-making process. Participants may need extra help and encouragement to recognize the potential benefits and consequently be willing to engage fully in the exercise.

Elements of what it might look like to provide additional help to participants can be seen in a later decision-analytic effort, in which the Puget Sound Partnership sought first to explore the potential for interest in the benefits that might derive from decision-analytic methods. During the 2014 iteration of the Action Agenda, the agency began to focus new attention on improving approaches to identifying and prioritizing *local* strategies and actions that help restore the Puget Sound to health. Recognizing that city and county governments will be the primary implementers of many of the priorities, strategies, and actions identified in the Action Agenda, local integrating organizations (LIOs) had been established and recognized by the Puget Sound Partnership Leadership Council to more clearly articulate local priorities. In each Action Agenda update, these priorities are to be reflected in choosing "near term actions" (NTAs) that are intended to reflect the "change agenda" of the Action Agenda.

As part of their efforts, the Puget Sound Partnership sought the help of decision science. The task was to develop a high quality prioritization process that could meet LIO needs to choose NTAs. Ultimately, the process established guidelines for recommended steps to follow, terminology to use, and desired information quality for 2016 revisions of the Action Agenda and beyond. But the effort started tentatively with a pilot study with a single LIO (Summer, 2013) in which decision-analytic themes were presented and used to help facilitate the process of choosing 2014 NTAs[9, 10]. This led to the adoption of a new set of NTAs for the pilot LIO as an amendment to the 2012 Action Agenda and initial enthusiasm about the potential benefits of decision analysis to all LIOs. It was followed in the Spring of 2014 by a formal review of the previous prioritization processes conducted by all LIOs, development of written guidelines for a new process informed by the review, and provision of introductory training in following the new guidelines.

[9] http://blog.pugetsoundinstitute.org/2013/09/decision-science-for-puget-sound-recovery/
[10] http://www.eopugetsound.org/articles/lessons-learned-island-local-integrating-pilot-process-selecting-near-term-actions-2014

The LIO decision support work appears to have gotten off to a good start, in part due to a gradual approach to implementation that sought the reactions and support of potential participants at each step of the way. This suggests that to be successful, future decision support must not only reflect the two methodological principles described above in this article, but also carry out a successful approach to organizing, supporting, and encouraging those who will be engaging in the decision analytic steps and tasks.

Other roles exist for decision support. Decision analysis offers techniques for prioritizing research efforts to reduce scientific uncertainties, as is currently underway within the Puget Sound Ecosystem Monitoring Program[11]. These techniques consider the costs of alternative research projects, how likely they are to reduce uncertainty, and whether a reduction might matter for achieving important endpoints. Similar considerations would apply for choosing science priorities in the Biennial Science Work Plan[12]. Finally, decision support could help with the development of implementation strategies planned by the Puget Sound Partnership for achieving vital signs[13], where proposed "recovery groups" are likely to be in the same position as LIOs, i.e., needing guidance about how to make decisions.

About Richard Anderson

Richard Anderson provides consulting services in decision analysis and natural resources management. He has over 12 years of experience using quantitative and qualitative models and working with teams of scientists, engineers, managers, consultants, and students to reach effective solutions to management problems in natural and engineered systems. He was a research scientist at the Puget Sound Institute at University of Washington Tacoma from 2012 to 2014, where he led the development of new procedures for groups of natural resource managers throughout Puget Sound to choose scientifically-based local priorities for action so that regional goals for ecosystem recovery could be better pursued.

[11] https://sites.google.com/a/psemp.org/psemp/news-and-announcements/psempmonitoringgapssummaryreleased
[12] http://www.psp.wa.gov/blog/?p=201
[13] http://www.psp.wa.gov/vitalsigns/