Finding a Place for Expert Opinion in Salmon Recovery[1]

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Abstract

Many contemporary fisheries and wildlife issues are complex, messy, and divisive. Most share a set of common characteristics including a lack of comprehensive scientific information, a limited understanding of biological processes, a scarcity of agency staff time and money, and a tendency for differences over policy preferences to end up as debates over scientific information. When pressured to provide policy relevant science to decision makers, agency scientists are often left with no choice but to rely on some form of expert opinion. Information based on expert opinion may be valuable, but to be most useful in decision making, it must be perceived as being accurate, transparent, and calibrated by some level of uncertainty. In response to a recognized need, formal methods of using expert opinion are becoming more common in fisheries and wildlife management. Decision-support models are one such method but are still fairly new and untested in their application to fish and wildlife problems. Using Oregon coastal coho salmon recovery as a case study, we examined and tested the usefulness of a decision-support model to assess watershed condition for coho. Preliminary results will be presented including the practical challenges of using such a tool on an actual policy problem.

Recovering US Endangered Species Act (ESA) and Canadian Species at Risk Act (SARA) listed stocks of anadromous salmon *Oncorhynchus spp.* is a central focus of natural resource management agencies in the Pacific Northwest of North America. Beyond the legal mandate, the economic, social, and ecological importance of salmon in this region is broadly accepted by the public, but specific recovery strategies are controversial and recovery remains an elusive goal. After years of analysis and the expenditure of billions of dollars, salmon runs are still greatly reduced compared to pre-1850 levels (Meengs and Lackey 2005).

Salmon recovery is an example of a contemporary natural resource problem commonly known as a "wicked problem" (Rauscher 1999) . Their shared characteristics include: inherent ecological complexity, fragmented or competing interest groups and stakeholders, a general lack of data, incomplete scientific understanding of the problem and the consequences of management actions, large but unknown costs, lack of organized approaches, and high uncertainty. Additionally, the exact problem may be difficult to define and the solutions obscured because of multiple interrelated, compounding factors (e.g. changing political goals, dueling scientists, and the continued use of ineffective approaches to solve these problems).

Often, these challenges are exacerbated by a lack of financial resources and time constraints. Given that it has the characteristics of a wicked problem, effective salmon recovery requires the collaboration and communication between scientists and decision-makers. In this relationship, decision-makers are under pressure to implement policies that achieve their organization's specific legal or policy mandates whereas scientists are expected to inform management decisions by providing the "best available scientific information" that is timely, relevant, and meaningful. Bisbal (2002, 2006) suggests that, although popular in use and even required by the ESA to guide salmon conservation, the definition of the "best available science" is vague. There is no consensus on what counts as the "best available science", how to differentiate between the best science and the rest, or how to determine the amount of science available (Bisbal 2002, Bogert 1994). When confronted by the wicked characteristics of the problem of salmon recovery, particularly incomplete data coupled with complexity and urgency, the "best available science" is often expert judgment.

Expert judgment is a valuable, even essential, source of information for the management and recovery of salmon (Magnuson et al. 1995). From national scientific panels to individual fisheries biologists, scientists interpret information and provide judgment at many levels that influence salmon management decisions. It is assumed that experts have the ability to make judgments and decisions based on incomplete data and imprecise understanding (Regan et al. 2004, Johnson and Gillingham 2004). Experts' additional challenge is to synthesize expert opinion in a way that is easy to understand and useful for decision making. In contrast to inferences based solely on empirical data, experts can provide a synthesis perspective gathered from a coordination of experience, personal observation, and published data (Johnson and Gillingham 2004). Also, expert judgment can substitute for empirical data that is cost prohibitive and time consuming to collect (Johnson and Gillingham 2004).

The use of expert judgment deserves caution based on its subjective nature. An expert may have a sound technical understanding of a subject, but there is no assurance that an expert's judgment process will follow the rules of rational thought or that the judgment will amount to useful information. Expert-derived information is susceptible to being undermined by personal values, perceptions of risk, and cognitive heuristics (Regan et al. 2004).

Rationality in judgment usually means "the person who estimates, values, or chooses thoroughly uses available information and is aware of alternatives and their implications and that the judgment is coherent, consistent with similar judgments, in agreement with general laws or probability, and understood by users (Cleaves (1994). Heuristics are psychological rules which have been proposed to explain how people make decisions, come to judgments and solve problems, typically when facing complex problems or incomplete information. These rules work well under most circumstances, but in certain cases lead to systematic cognitive biases (Tversky and Kahneman 1982).

It is often difficult to understand an expert's logic or hidden reasoning underlying his or her assumptions (Regan et al 2004). Therefore, expert based assessments and decisions are difficult to repeat. Lack of repeatability can potentially weaken the credibility of decisions and assessments based on expert judgment by hiding inconsistencies, values, illogical assumptions, or "normative" science (e.g., normative science presupposes a particular policy position or preference) (Lackey 2004). As a result, expert judgment that is *presumed* to be biased in favor of a particular policy preference may be not be accepted for use even if it is not biased. Scientists perceived as biased lose their credibility, and policymakers will likely ignore any scientific information they provide (Rykiel 2001). The worst case is when management decisions are made based on biased or misleading information that unexpectedly and irretrievably damages the resource or result in undesirable consequences (Johnson and Gillingham 2004).

Like scientific information, expert judgments are most useful if they are calibrated by a measure of uncertainty, communicated intelligibly and meaningfully, and most importantly, if they are perceived as credible (Ellison 1996). The credibility of expert judgment is dependent on its transparency, repeatability, and defensibility, qualities affected in part by how expert judgment is elicited. Methods of eliciting expert judgment may be formal or informal. Formal methods for elicitation explicitly document information and sources, use consensus building, and demonstrate transparently logic paths and assumptions. One formal method of expert solicitation is the Delphi technique in which judgment is solicited anonymously from an expert panel, summarized, and returned to the each expert for reconsideration (Crance 1987). The process is repeated until consensus is reached.

The Delphi technique is just one formal method to elicit and integrate expert opinion. Alternatives methods to the Delphi technique include one-shot group averages, group discussions, and the Nominal Group technique. One-shot group averages provide a single chance for expert panelists to provide their input before averaging the group's answers. Its advantage is speed. In general, one-shot group averages lack enough time for participants to give their most thoughtful input and do not allow participants to hear each other's ideas that could influence and help refine their own ideas. Group discussions between experts are unrestricted during a face-to-face meeting. They are administratively difficult to coordinate and expensive to bring all participants together. Group discussions are susceptible to group dynamics (e.g. dominant individuals control the decision process) and can obscure objective information (Clayton 1997). The Nominal Group Technique uses the Delphi process in a face-to-face setting without the anonymity of expert input (participants read their answers aloud to the group for feedback) (Delbecq et al. 1975). In addition to sharing the same cost and administrative problems as the basic group discussion method, the lack of anonymity may influence how individuals participate. The advantages of the Nominal Group technique are structured input and summarized feedback. Informal methods to elicit expert judgment have no formal rules for how information is gathered or combined and may be as simple as asking a single expert a few casual questions.

Once elicited, expert judgment is applied to the decision making process. Like elicitation, these methods of decision making can also be informal or formal. Formal methods are defined as models that demonstrate more transparently how a specific conclusion is reached. As an example, decision support models are computer models that capture logical evaluation procedures for consistent application to a decision process (Gallo et al. 2005). They allow the user to observe how model parameters are related and where data synthesis occurs in the evaluation process. When discrepancies in model outputs occur, the causes can be determined. Informal methods (*e.g*. black box models) provide little ability judge the quality or validity of resulting assessments because the user cannot evaluate the inner workings of the model. Consequently, formal methods of acquiring and applying expert judgment are most credible in decision making.

Neither informal or formal methods for eliciting or applying expert judgment is inherently the best choice. Both methods have pros and cons and are suitable for different circumstances and situations. Essential considerations include time constraints, data availability, resources, complexity of goals, the number of experts, whether or not consensus is needed, and then subsequently, how to build consensus. Formal methods require more time, money, planning, technical models, explicit procedures, and depending on the problem, a large number of experts. Informal methods are time-efficient, have no constraints or formal rules, and may be as simple making a few phone calls to a single expert for advice.

We applied some of the above techniques to a case study (*i.e.,* at-risk coho salmon residing in watersheds along the Oregon Coast). The case study is described in the Master of Science thesis written by the senior author ("The Utility of a Decision-support Model to Assess Watershed Condition for Salmon Recovery").

The key question addressed was "how useful is a decision-support model likely to be in assessing watershed condition?" We found that the Delphi technique is relatively inefficient and impractical for eliciting expert opinion on such topics as complex as watershed condition. We also identified ways that normative science can negatively influence the consensus building process. Once the decision-support model was constructed, we determined that it was not particularly useful for assessing watershed condition for coho salmon at the population level due to the lack of credible data. Data for all of the road parameters in the knowledge base were either nonexistent, or not available because they are privately owned or require extensive additional analysis. In the case study we evaluated the tradeoffs of the various formal methods. Improving credibility and transparency came at the cost of time and procedural efficiency. Formal methods of eliciting and applying expert opinion for assessments are not a panacea. Managers and decision-makers will need to weigh the pros and cons on a case-by-case basis when contemplating whether these tools will add appreciable value to assessments.

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