RECLAMATION

Managing Water in the West

Managing Disputes over Science: Contested Factors

Research and Development Office
Science and Technology Program
Final Report 202014-011380

Douglas R. Clark, Ph.D., Denver Technical Services Center

Research and Development Office
Bureau of Reclamation
U.S. Department of the Interior

September 2014

Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Cover photo: A Colorado School of Mines peer review of Reclamation's risk analysis of the Leadville Mine Drainage Tunnel vindicated agency science and allayed public safety concerns.

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188
T1. REPORT DATE 09/14	**T2. REPORT TYPE** Research	**T3. DATES COVERED** 2011
T4. TITLE AND SUBTITLE Managing Disputes over Science: Contested Factors		**5a. CONTRACT NUMBER** 14XR0680A1-RY154DS201411380
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER 1541
6. AUTHOR(S) Douglas R. Clark, Ph.D. drclark@usbr.gov **303-445-2271**		**5d. PROJECT NUMBER** X1380
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER 86-68260
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Douglas R. Clark, Denver TSC, PO Box 25007, Mail Code 86-68260, Denver Federal Center, 6th Avenue and Kipling, Lakewood, CO 80225		**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Research and Development Office U.S. Department of the Interior, Bureau of Reclamation, PO Box 25007, Denver CO 80225-0007		**10. SPONSOR/MONITOR'S ACRONYM(S)** **R&D: Research and Development Office** **BOR/USBR: Bureau of Reclamation** **DOI: Department of the Interior**
		11. SPONSOR/MONITOR'S REPORT NUMBER(S) **202014-011380**
12. DISTRIBUTION / AVAILABILITY STATEMENT **Final report can be downloaded from Reclamation's website: https://www.usbr.gov/research/**		
13. SUPPLEMENTARY NOTES		

14. ABSTRACT *(Maximum 200 words)* This research sought to examine the importance of seven factors commonly found in disputes over science using an electronic survey of Reclamation managers and professional staff. Analysis of survey data yielded the following rank order: 1. *inferences drawn from the science*, 2. *whether or not the existing science addressed the critical issues*, 3. *the level of uncertainty in the science*, 4. *the quality of the data used*, 5. *the need for additional scientific investigation*, 6. *whether or not science should be the basis for the management decision*, and 7. *the qualifications of the scientists who produced the science*. Further results indicated that to manage these issues, collaborative processes showed promise. Respondents wrote in other factors they also considered to be important contentious issues. In rank order from most to least important these were *purely scientific differences*, *political differences*, *institutional policy or legal concerns*, *budgetary limitations*, and individual *bias*.

15. SUBJECT TERMS: Conflict management, water conflict, disputes over science

16. SECURITY CLASSIFICATION OF: U			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Douglas R. Clark
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U	U	39	19b. TELEPHONE NUMBER 303-445-2271

S Standard Form 298 (Rev. 8/98)
P Prescribed by ANSI Std. 239-18

PEER REVIEW DOCUMENTATION

Project and Document Information

Project Name SCOPING TOOLS FOR WATER CONFLICT WOID X1380

Document ~~MANAGING~~ MANAGEMENT DISPUTES OVER SCIENCE: CONTESTED FACTORS

Document Author(s) DOUGLAS R. CLARK, Ph.D. Document date 9/30/14

Peer Reviewer KIMBERLY OGREN

Review Certification

Peer Reviewer: I have reviewed the assigned items/sections(s) noted for the above document and believe them to be in accordance with the project requirements, standards of the profession, and Reclamation policy.

Reviewer (Signature) Kim Ogren Date reviewed 9/15/14

Acknowledgements

The author would like to acknowledge the support and funding of the Reclamation Research and Development Office. Dr. Curtis Brown, in particular, provided extensive guidance at every step of the development of this survey. Mr. Dennis Kubly, Manager of Adaptive Management for the UC Region, also provided extensive support and constructive criticism for this project.

Executive Summary

This research sought to examine the importance of seven factors commonly found in disputes over science using an electronic survey of Reclamation managers and professional staff. The factors included the following:

1. Whether or not the existing science addressed the critical issues
2. The quality of the data used
3. The inference(s) drawn from the science
4. The level of uncertainty in the science
5. The need for additional scientific investigation
6. Whether or not science should be the basis for the management decision
7. The qualifications of the scientists who produced the science

It also examined the importance of the factors with respect to various tools commonly used to manage disputes over science. These included direct discussions amongst scientists, independent expert review, conducting additional science, active collaborative processes, public education, and adaptive management.

There was considerable variation in the importance of each of the factors. Analysis of the data indicated that respondents ranked them as follows from most to least important:

1. Inferences drawn from the science
2. Whether or not the existing science addressed the critical issues
3. The level of uncertainty in the science
4. The quality of the data used
5. The need for additional scientific investigation
6. Whether or not science should be the basis for the management decision
7. The qualifications of the scientists who produced the science

Various methods for managing these differences were offered up for respondents to choose. They included direct discussions between scientists, independent expert review, conducting more science, collaborative processes, public education, and adaptive management.

Overall the most complex dispute resolution methods, with the exception of collaborative learning, experienced the most severe intensities of the seven listed factors namely, expert review and adaptive management. In the middle level of complexity, the need for additional scientific investigation scored highly. Interestingly, the most “trouble free” method was active collaboration, perhaps because the very fact that parties were, by definition, collaborating made them less susceptible to the 7 listed factors of concern. This seems to suggest that Reclamation might find benefit in investing collaborative processes, at least where these 7 factors are concerned.

The respondents also noted a variety of other factors that were sometimes germane to the disputes over science. In rank order from most to least important were purely scientific differences, political differences, institutional policy or legal concerns, budgetary limitations, and individual bias.

Contents

Purpose

The purpose of this report is to examine the extent to which specific factors are at issue in water disputes over science. This is the first in a series of reports on an electronic survey of Reclamation employees focused on how they managed disputes over science. Reclamation makes numerous water management decisions to fulfill its mission. Science and technical data are often the bases for these decisions. However, sometimes Reclamation becomes involved in disagreements with other agencies over technical data, methods, or findings, which are sufficiently serious to impede a water resource management decision. We called these *disputes over science* and they were the focal point of this survey.

Research Methods

Respondents who had been involved in a dispute over science were first asked to identify the most recent dispute over science they had been involved with and then select what dispute resolution method or tool they used to manage it. Several prominent methods were listed as options.

- *Direct Discussions Between or Among Scientists*: Processes that bring technical experts involved in a science dispute together to identify areas of agreement and disagreement, data needs and gaps, scientific protocols, and potential approaches to resolving technical disputes.
- *Independent Expert Review*: One or more outside experts review the disputed science and reach conclusions regarding the weight of the evidence and the adequacy of the science.
- *More Science and Analysis Independently of the Other Parties:* Reclamation undertakes additional studies or analyses in an effort to address concerns or conflicts.
- *Active Collaboration in Research and Analysis:* The outside parties involved in the dispute engage with Reclamation in collaborative science, jointly undertaking scientific training, hypothesis development, data collection, model building, or data analysis.
- *Public Education, Data Sharing, and Results Dissemination:* Outreach activities designed to inform the public and stakeholders about the technical issues, existing data and science, and Reclamation's analysis of the information.
- *Adaptive Management:* A planned program of experimentation and adaptive decision-making based on scientific feedback used to address uncertainties or differences over science, and the management of water and related resources.

The survey next asked the respondents to indicate the extent to which the following factors were contested in the most recent dispute over science with which they had been involved (and, again, for which they used the dispute resolution methods just listed):

- Whether or not the existing science addressed the critical issues
- The quality of the data used
- The inference(s) drawn from the science

- The level of uncertainty in the science
- The need for additional scientific investigation
- Whether or not science should be the basis for the management decision
- The qualifications of the scientists who produced the science

Each employee was asked to rate the intensity to which each of the 7 factors just listed was contested on a scale of 1 to 5, with 1 being lowest intensity and 5 being highest intensity. Finally, each respondent was also given the opportunity to list some "other" factor beyond the seven listed as being in dispute. The responses to this "other" category will be discussed separately.

In this section of the survey we wanted to determine the extent or intensity to which any of the listed seven factors were in play for all respondents and also with respect to those sub-groups who chose each of the dispute resolution methods. Two-way analyses of variance were conducted for the percentage weight categories over all the methods. For each factor significant differences appeared among the weights (1-5), but not among methods. We took the additional step, however, of conducting tabular and graphic analyses between methods for each factor. We wanted to know the extent to which dispute resolution methods were weighted *more toward 5*, *more toward 1*, or *somewhere in the middle*. Tabular and graphic analyses can sometimes reveal subtle differences. Anticipating that some frequency distributions would be top or bottom-heavy, we devised (a. a simple ratio of the frequency of the highest two percentages to the lowest three, which made use of all the weighted data and (b. the ratios of 5s to 1s. For the first ratio, the theoretic range would be from $\rightarrow 0/5$, if the weights were concentrated on the low end to $\rightarrow 5/0$, if they were concentrated in the high end. On the other hand, if the weights were equally distributed over all values from 1 to 5, i.e. 20% for each, then the ratio for the (5+4)/(1+2+3) would be $40/60 = 2/3 \approx 0.67$. Any number above 0.67 would show that the distribution was inclined toward the 4s and 5s, and any number below 0.67 showed that the weights were inclined toward the 1s, 2s, and 3s. For the second ratio, the 5 to 1 ratio, of course, the fraction would be $20/20 = 1$ if there was an equal balance, and any number above 1 would indicate top heaviness and any number below 1 would indicate bottom heaviness.

Whether or not the existing science addressed the critical issues

Figure 1.1.1, shows the percentage distribution by weight over all responses and all dispute resolution methods lumped together for the first factor: "existing science". The graph indicates that, in general, respondents considered that the state of the existing science was indeed an important issue for the disputes in which the respondents were involved. In other words, the percentage distribution is clearly "top heavy", with the highest percentages occurring in the 4-5 weight range. The ratio of the top two categories to the bottom 3 was 1.5, well above 0.67. The median weight overall was 4 and the ratio of the 5s to 1s was 2.4.

Table 1.1.1 shows the numeric breakdown of the weights for each of the dispute resolution methods. Figure 1.1.2 depicts the 1-5 weighted percentages graphically for each of the dispute resolution methods. Finally, Figure 1.1.3 shows the ratio of the 5 weights to the 1 weights for each of the methods.

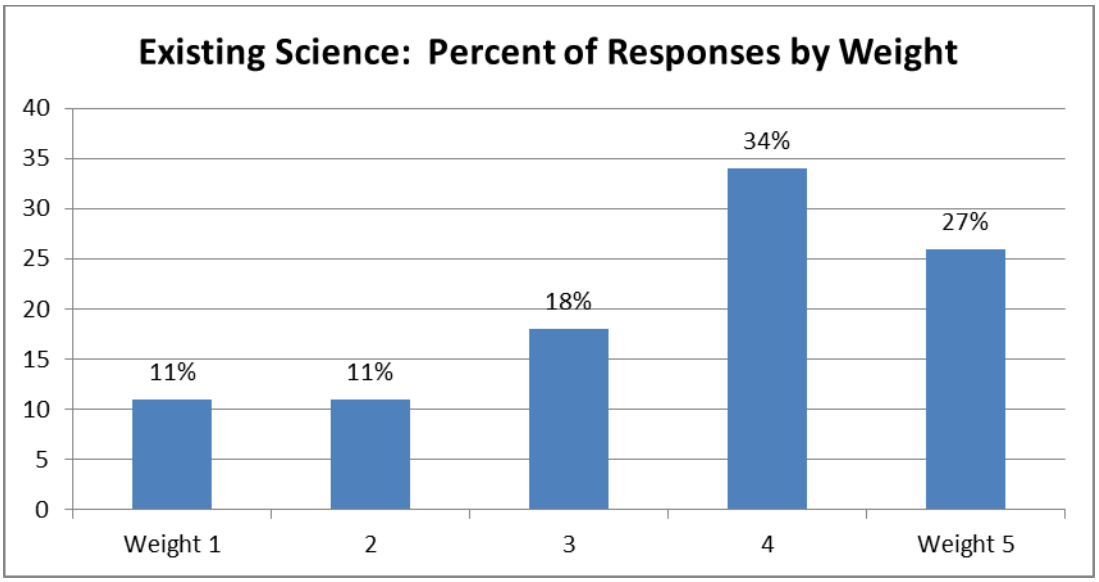

Figure 1.1.1: Whether the existing science addressed the critical issues. Overall percentage distribution of the weighted responses.

Table 1.1.1: Percentage distribution of weights for the factor, "Whether or not the existing science addressed the critical issues."

Whether or not the existing science addressed the critical issues.									
Method	Percent of Method Total							Median	Ratio H/L
Selected	1	2	3	4	5	N/A	Don't Know	Weight	(4+5)/(1+2+3)
Direct Discussions	10.6	14.1	19.7	28.9	22.5	1.4	2.8	4	1.2
Expert Review	12.7	5.1	8.9	40.5	30.4	2.5	0.0	4	2.7
More Science	8.5	9.8	15.9	32.9	29.3	2.4	1.2	4	1.8
Collaboration	14.0	9.0	23.0	28.0	17.0	4.0	5.0	3	1.0
Public	8.0	14.7	17.3	36.0	18.7	2.7	2.7	4	1.4
Adaptive Mg'mt	7.0	12.7	18.3	26.8	31.0	0.0	4.2	4	1.5
Mean	**10.1**	**10.9**	**17.2**	**32.2**	**24.8**	**2.2**	**2.7**		**1.6**

The median weights were nearly all 4s (Table 1.1.1). “Collaborative methods” was the exception. The most apparent pattern is “top-heaviness” for each of the methods, i.e. the weights of 4 and 5 predominated over the 1s, 2s, and 3s: direct discussion, expert review, more science, collaborative approaches, public outreach, and adaptive management. Differences are evident from method to method. The more complex methods, generally reserved for more entrenched disputes, were particularly top-heavy, as exemplified by the ratios of high to low weights (Table 1.1.1): expert review (2.7), Reclamation undertakes more science (1.8), and adaptive management (1.5). Adaptive management was noteworthy because the percentage of 5’s predominated over every other weight category and this was unique amongst the various methods.

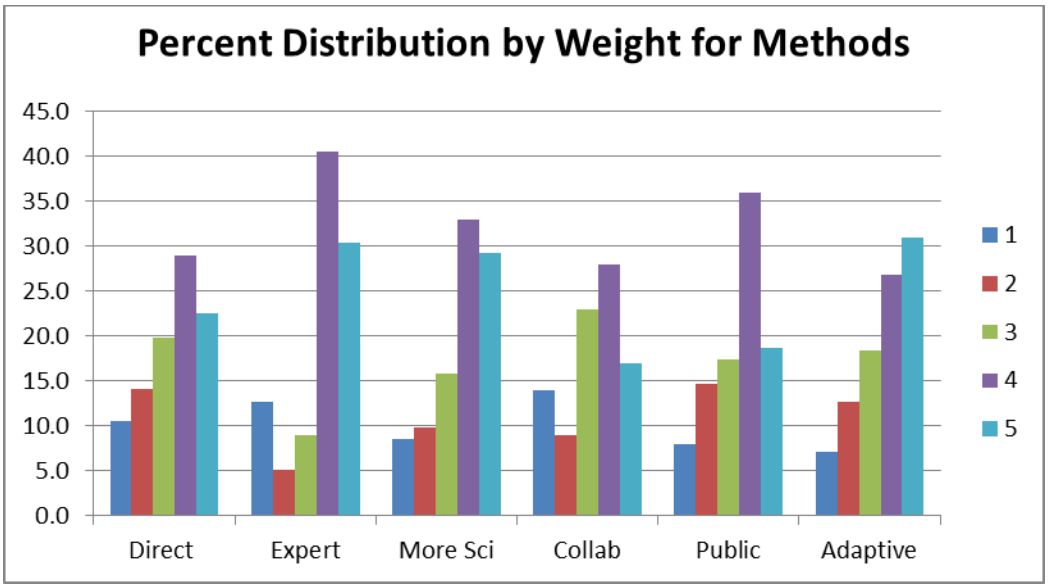

Figure 1.1.2: Frequency distributions for individual methods for the factor, "Whether or not the existing science addressed the critical issues."

The least top-heavy method was collaboration, perhaps indicating that the scientists using this method were at least on good enough terms to view themselves as "in this scientific endeavor together", and thus, the existing science was jointly owned. Evidently, disputes over the existing science were also pronounced for conflicts where public outreach was necessary (H/L: 1.4), perhaps indicating that the public was an active participant in the scientific discussion.

Switching to the 5 to 1 ratios exclusively, seen in Figure 1.1.3, we find again that expert review (2.4), more science (3.4), and adaptive management (4.4) showed the highest ratios with collaboration showing the lowest (1.2).

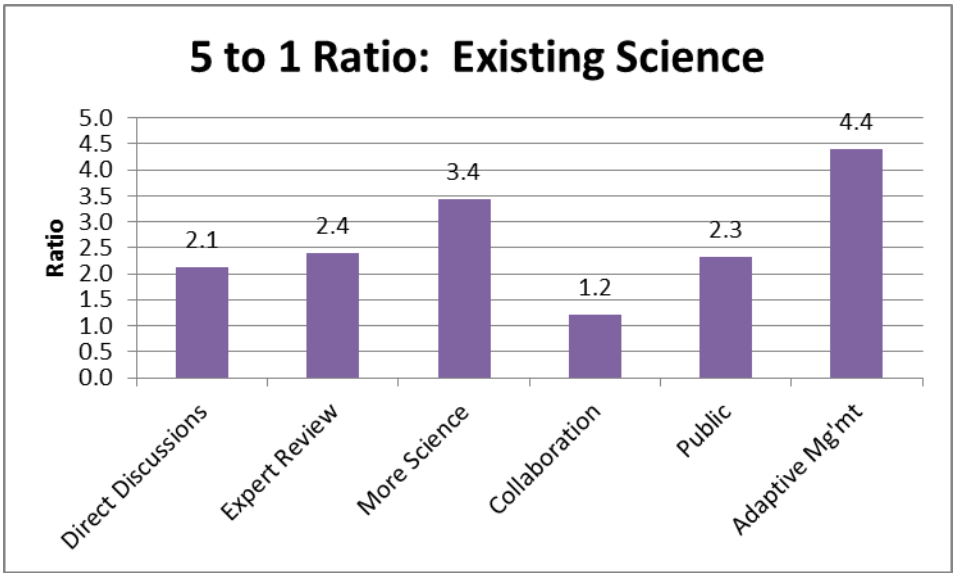

Figure 1.1.3: Ratio of 5 to 1 weights for the factor, "Whether or not the existing science addressed the critical issues."

The quality of the data used

The next disputed factor was the quality of the data used in the scientific enterprise. Table 1.2.1 and Figures 1.2.1, 1.2.2, and 1.2.3 summarize the results. The weighted percentages were again top-heavy with a median of 4 and a top to bottom ratio of 1.1 (Figure 1.2.1, Table 1.2.1), but somewhat less so than for the adequacy of the existing science issue. More clustering in the range of 3 and 4 occurred as compared with the previous histogram.

Dispute resolution method-to-method differences were visible (Figure 1.2.2, Table 1.2.1). Direct discussions and adaptive management had median weights of 3, indicating that perhaps data quality issues, while present, were not as pronounced when these methods were used. The rest of the methods showed median weights of 4, indicating that data quality was more of an issue when they were used.

With respect to the high to low ratios, more science (H/L=1.3) and public education (1.3) led the other methods where data adequacy was concerned, followed closely by collaborative processes (1.2). Expert review showed a ratio of 1.0. Again adaptive management (0.9) and direct discussions (0.9) scored lowest on these measures, followed closely by expert review (1.0). Perhaps by the time that the need for expert review or adaptive management were viewed as desirable, and initiated, data quality issues had been mitigated, at least in some instances.

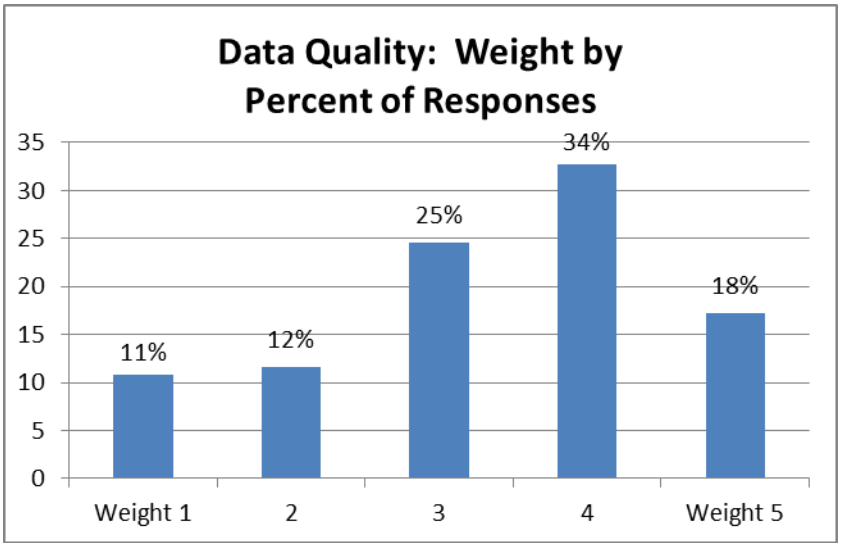

Figure 1.2.1: The quality of the data used. Overall percentage distribution of the weighted responses.

Table 1.2.1: Percentage distribution of weights for the factor, "The quality of the data that were used."

The quality of the data that were used.									
Method Selected	Weights: Percent of Method Total 1	2	3	4	5	N/A	Don't Know	Median Weight	Ratio H/L (4+5)/(1+2+3)
Direct Discussions	13.0	9.6	28.8	28.1	16.4	2.1	2.1	3	0.9
Expert Review	11.5	10.3	26.9	33.3	15.4	1.3	1.3	4	1.0
More Science	9.8	11.0	20.7	35.4	19.5	2.4	1.2	4	1.3
Collaboration	9.8	12.2	22.0	32.9	19.5	1.2	2.4	4	1.2
Public	9.3	13.3	20.0	36.0	18.7	2.7	0.0	4	1.3
Adaptive Mg'mt	11.0	15.1	24.7	35.6	12.3	0.0	1.4	3	0.9
Mean	**10.7**	**11.9**	**23.8**	**33.6**	**17.0**	**1.6**	**1.4**		**1.1**

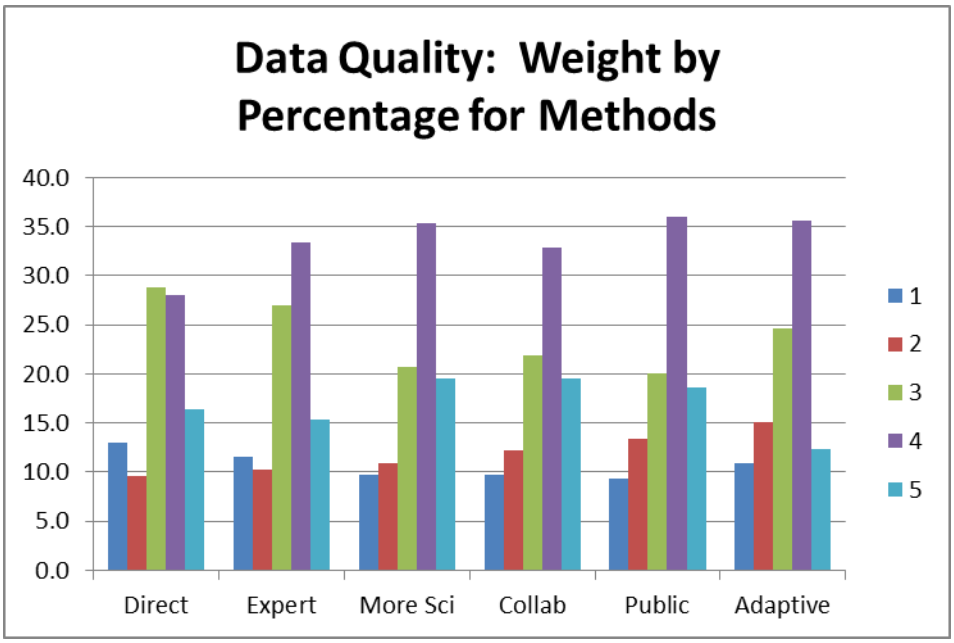

Figure 1.2.2: Frequency distributions for individual methods for the factor, "The quality of the data that were used."

Turning to the "5-1" ratios, as with the high to low ratios, adaptive management, direct discussions, and expert review showed the lowest ratios and more science, collaboration, and public education were the highest. Once again, one might postulate that by the time that the most complex dispute management methods, namely expert review and adaptive management, were initiated, data quality issues had perhaps been resolved or were of less concern. Perhaps for direct discussions, which generally occur early on, data quality was not yet an issue. But for methods such as more science and collaboration, it was most definitely an issue. Finally, where public outreach was used, data quality was seen to be at issue, likely for stakeholders.

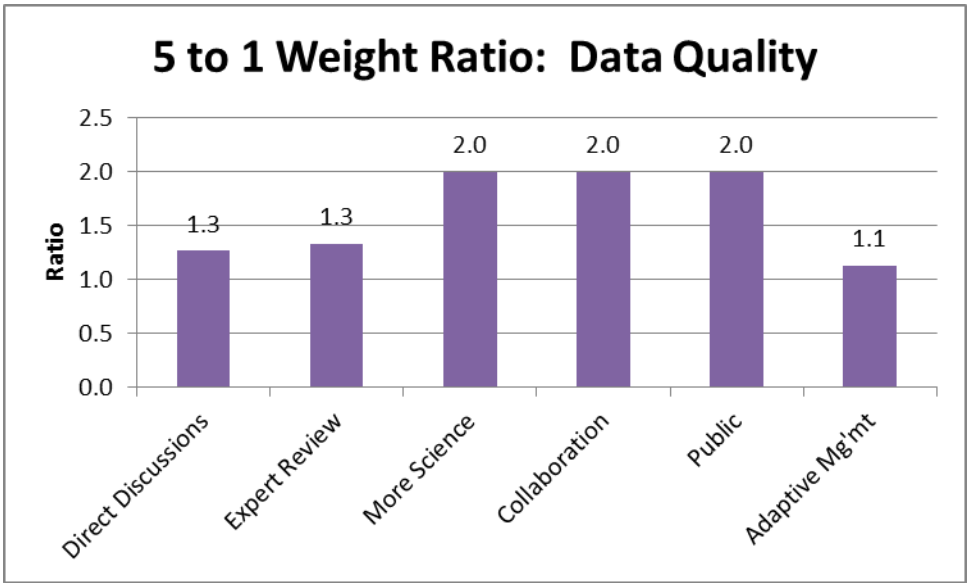

Figure 1.2.3: Ratio of 5 to 1 weights for the factor, "The quality of the data that were used."

Overall, it appears that data quality issues were likely to appear when any of the six methods were used, but least likely for the most complex dispute resolution methods. Overall, Figure 1.2.1 shows, data quality was generally disputed, but was less so than the adequacy of the existing science.

The inference(s) drawn from the science

Scientists sometimes differ with respect not only to what science needs to be conducted and how, but also with respect to what the findings mean. For instance, laboratory experiments have shown that tamarisk consumes extremely large quantities of water, but can the results of these experiments be extrapolated to trees living in Western riparian zones? Scientists have disputed this question. We sought to learn whether the factor of inferences drawn from the scientific enterprise for Reclamation disputes over science was of wide concern. Figures 1.3.1, 1.3.2, and 1.3.3, and Table 1.3.1 indicate that it emphatically was. The median weight over all observations was 4 and the high to low ratio was 2.3 (Figure 1.3.1). The frequency distributions for each dispute resolution method were universally top heavy as well. The median weights were invariably 4 (Table 1.3.1).

As the ratios in Table 1.3.1 and the bar graphs in Figure 1.3.2 indicate, though, the inferences drawn from the science were especially pronounced for the direct discussion (2.8), expert review (2.4), and more science methods (2.3). And while adaptive management had a lesser ratio (1.6), it was the only bar graph where the 5 weights predominated over the others. Those making use of the public involvement method also showed a pronounced interest in inferences drawn from the science, indicating, perhaps, that the various publics might have an interest in and questions about the inferences drawn from the science. Collaborative processes showed a lower score on this factor when compared with most of the others, coming in at 1.9. Perhaps the fact that collaboration and adaptive management methods require scientists to work closely with one another served to mitigate the problems surrounding inference relative to other methods.

Figure 1.3.3, showing the 5-to-1 ratios, further underscores how important this factor was overall and for each of the dispute resolution methods. Indeed, the lowest ratio of 3.5 was for collaborative processes followed by public outreach (5.8), adaptive management (6.3), direct discussions (6.8), expert review (12.0), and more science (29.0). This last number is particularly striking. One might speculate that recourse to more science might be the universal "back-to-the drawing-board" answer when the inferences drawn from the science were in question by one or more of the parties. Those doubting the inferences drawn from the science would call for "more science" and those who had produced the science could well be confident in what would be found. In any event, inferences drawn from the science represented an extremely important factor or issue of concern both overall and across methods.

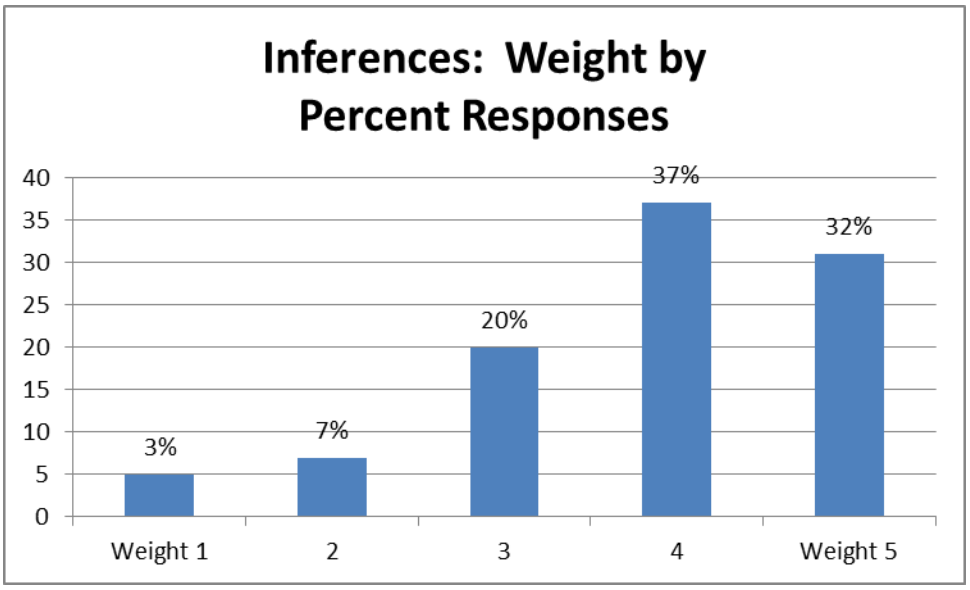

Figure 1.3.1: Percentage distribution of weights for the factor, "The inference(s) drawn from the science."

Table 1.3.1: Percentage distribution of weights for the factor, "The inference(s) drawn from the science."

The Inference(s) Drawn from the Science									
Method Selected	Weights: Percent of Method Total							Median Weight	Ratio H/L (4+5)/(1+2+3)
	1	2	3	4	5	N/A	Don't Know		
Direct Discussions	4.1	6.2	15.1	42.5	28.1	1.4	2.7	4	2.8
Expert Review	2.6	9.0	17.9	35.9	30.8	2.6	1.3	4	2.3
More Science	1.2	6.2	21.0	32.1	35.8	1.2	2.5	4	2.4
Collaboration	7.3	6.1	19.5	35.4	25.6	3.7	2.4	4	1.9
Public	5.3	6.7	20.0	34.7	30.7	1.3	1.3	4	2.0
Adaptive Mg'mt	5.5	5.5	27.4	26.0	34.2	0.0	1.4	4	1.6
Mean	**4.3**	**6.6**	**20.2**	**34.4**	**30.9**	**1.7**	**1.9**		**2.2**

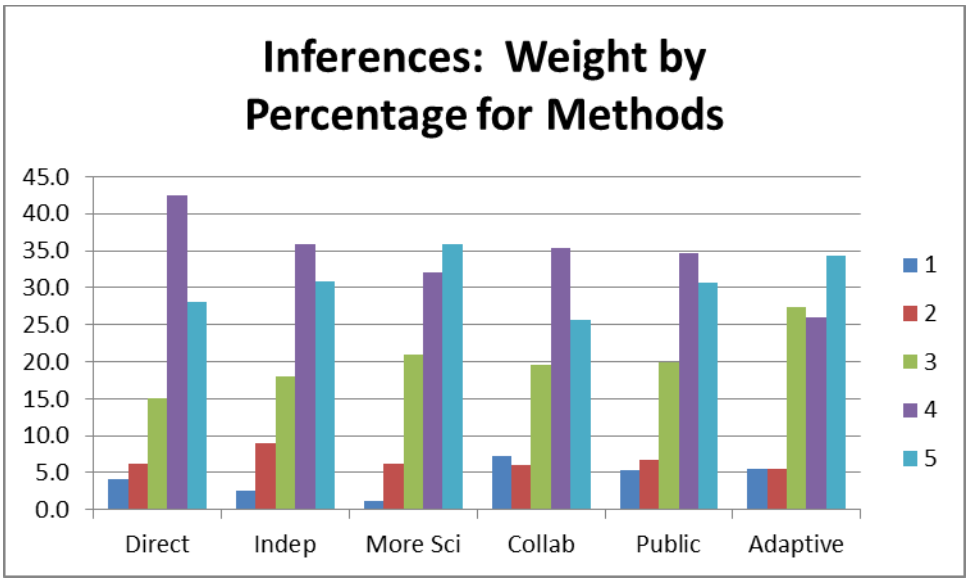

Figure 1.3.2: Frequency distributions for individual methods for the factor, "The inferences drawn from the science."

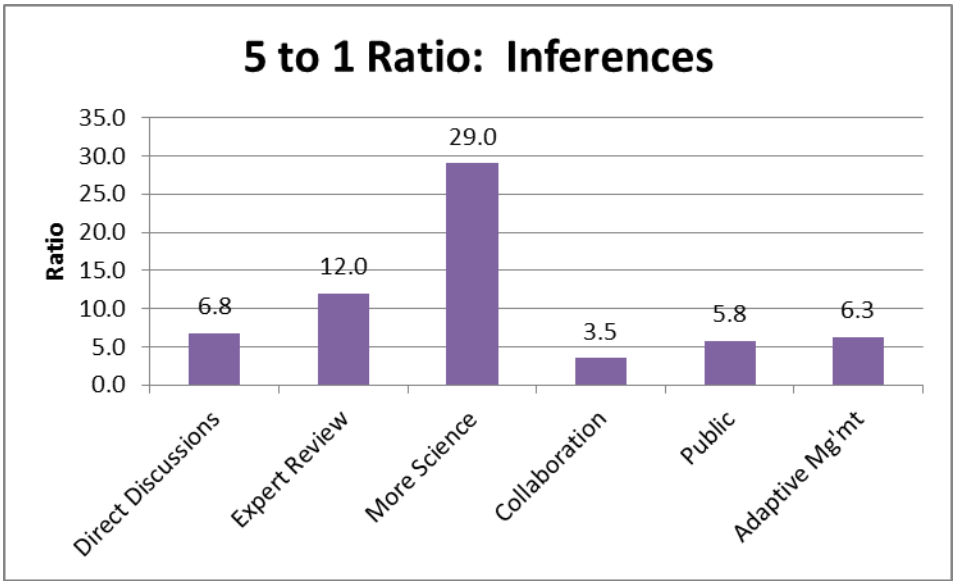

Figure 1.3.3: Ratio of 5 to 1 weights for the factor, "The inferences drawn from the science."

The level of uncertainty in the science

While uncertainty in the science is surely at issue whatever dispute resolution method may be applied, it is especially, by definition, relevant to adaptive management, an approach that identifies alternate ways to manage natural resources such river systems in an environment of uncertainty. While, again, this issue could inform any of the various methods, we thought that it would feature prominently in more complex disputes where methods such as adaptive management and expert review (which often accompanies adaptive management processes

(personal communications with Reclamation adaptive management experts, Curtis Brown and Dennis Kubly, 01/06/14)). Figure 1.4.1 (median 4 and ratio 1.4), Figure 1.4.2, and Table 1.4.1 all show that uncertainty was an important factor in the view of Reclamation respondents. This fact was particularly true when adaptive management (ratio 1.6), expert review (1.6), and collaborative process methods (1.5) were being used. The mean high/low ratio was 1.4 over all methods and the median weights were again invariably 4. Thus, uncertainty can be said to have been an issue of considerable importance in most of the scientific dispute resolution processes Reclamation managed.

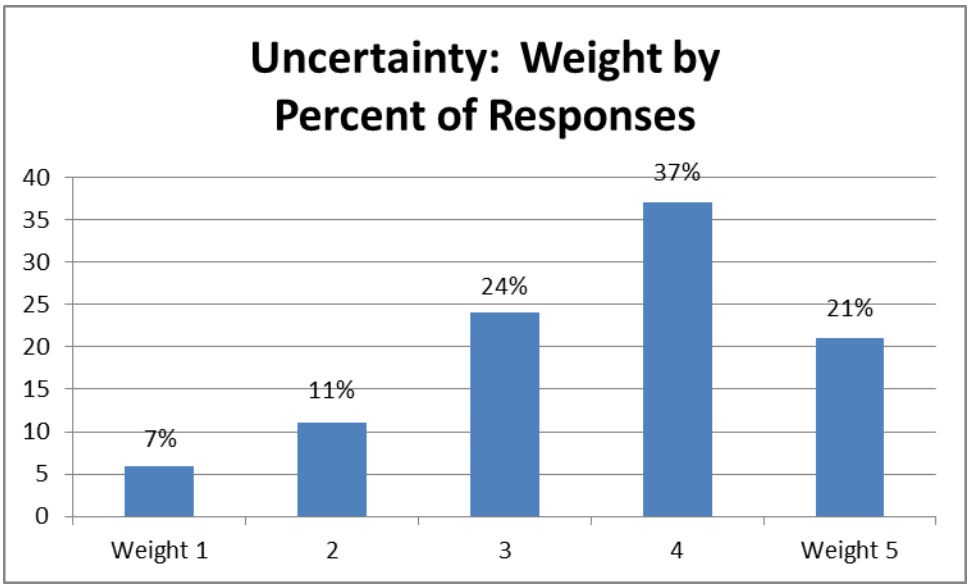

Figure 1.4.1: Percent distribution of weights for the factor, "The level of uncertainty in the science."

Table 1.4.1: Percentage distribution of weights for the factor, "The level of uncertainty in the science."

The Level of Uncertainty in the Science									
Method Selected	Weights: Percent of Method Total							Median Weight	Ratio H/L (4+5)/(1+2+3)
	1	2	3	4	5	N/A	Don't Know		
Direct Discussions	8.3	13.8	21.4	34.5	19.3	0.7	2.1	4	1.2
Expert Review	5.2	5.2	27.3	36.4	23.4	1.3	1.3	4	1.6
More Science	2.5	8.8	31.3	36.3	17.5	1.3	2.5	4	1.3
Collaboration	7.4	14.8	16.0	37.0	18.5	3.7	2.5	4	1.5
Public	9.3	9.3	24.0	33.3	21.3	1.3	1.3	4	1.3
Adaptive Mg'mt	4.1	12.3	21.9	37.0	24.7	0.0	0.0	4	1.6
Mean	6.1	10.7	23.6	35.7	20.8	1.4	1.6		**1.4**

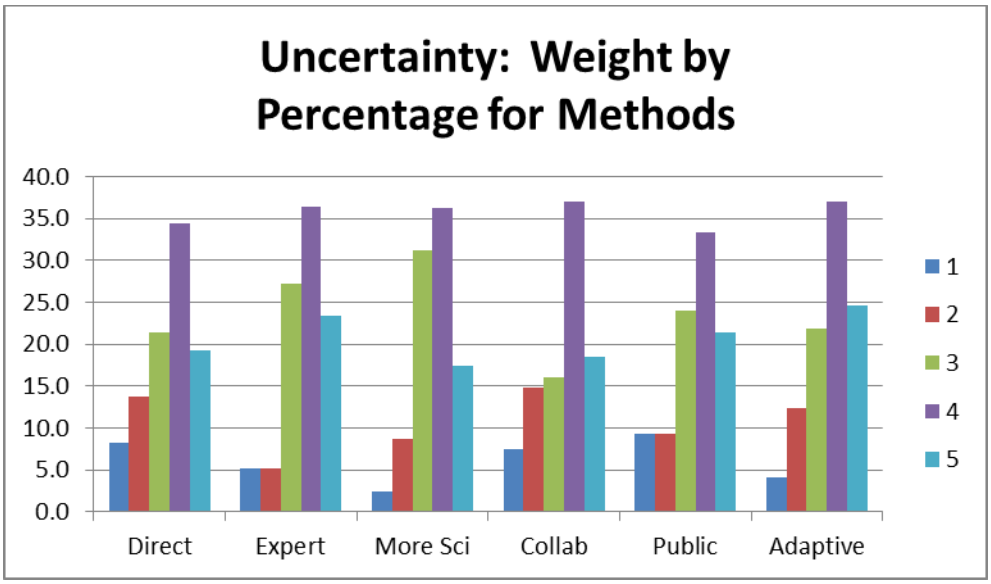

Figure 1.4.2: Frequency distributions for individual methods for the factor, "The level of uncertainty in the science."

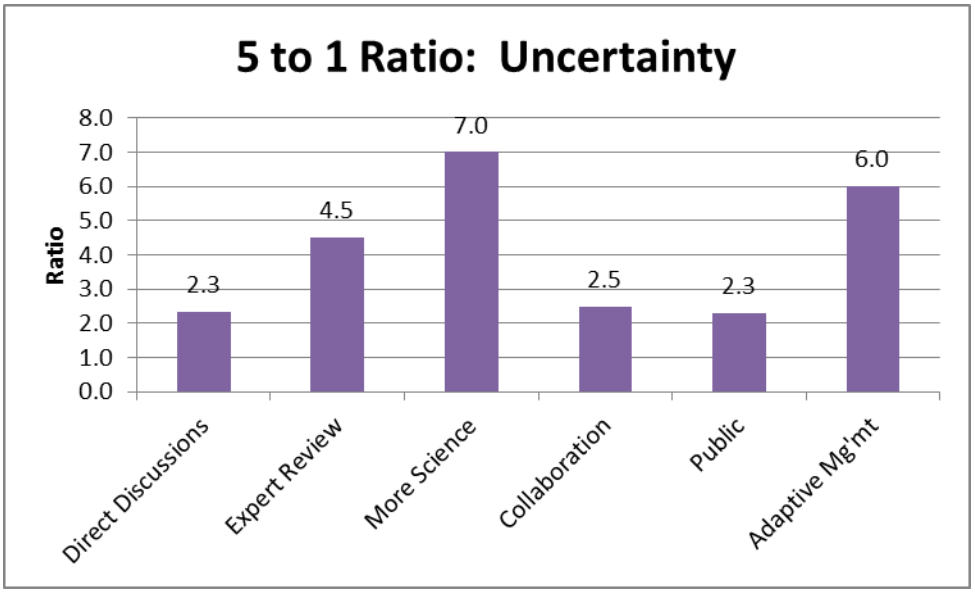

Figure 1.4.3: Ratio of 5 to 1 weights for the factor, ""The level of uncertainty in the science."

Figure 1.4.3 shows that when the highest and lowest weights were set against one another, adaptive management (6.0) and expert review (4.5) were again among the highest ratios. More science also scored highly at 7.0. Again, one might speculate that the requirement for more science might become especially apparent when uncertainty or perceived uncertainty was pronounced. Overall, without exception the ratios for this factor were well above unity, indicating the overall importance of this factor in disputes over science.

The need for additional scientific investigation

The need for additional scientific investigation appears when there are actual or perceived gaps in the science that pertain to a specific water dispute. Presumably, this would especially be the case in complex disputes. Given Reclamation's history with knotty disputes over whether endangered species were truly imperiled by the bureau's operations, we expected this issue to be of some considerable importance with median weights over all methods in the range of 4 to 5. By definition, two of the proffered methods are designed to fill such gaps, namely, conducting more science and adaptive management, so we suspected that for these methods, the weights would be high. Figure 1.5.1 shows, the need for additional scientific investigation was of less importance than the previous factors (median 3, ratio 0.8), i.e., less top-heavy. The 5 to 1 ratio was 1.0.

Table 1.5.1 indicates an overall high to low ratio of 0.9 averaged across all methods and median weights for the various methods in the 3 to 4 range. As predicted, methods that by definition address gaps in science, namely adaptive management (0.9) and Reclamation conducts more science (1.0), showed the highest high to low ratios. Figure 1.5.2 shows these methods to be particularly "top-heavy". In addition, public outreach (0.8) showed fairly highly again, perhaps indicating public concern about the overall adequacy of the science. Finally, again, and perhaps significantly, collaborative processes, with a very small ratio of 0.6, raised the prospect that the factor of the need to conduct additional investigation was less of an issue when a cooperative learning process was used. Overall, then, the need for additional investigation was of less concern than some of the other factors, but its appearance in those processes, which by definition address such factors, such as more science and adaptive management, was pronounced.

The 5 to 1 ratios (Figure 1.5.3) showed that more science, adaptive management, and expert review, often associated with adaptive management, again showed the highest ratios. Collaborative competencies showed the lowest, perhaps indicating that with this method the need to do more science was minimized or was already incorporated in the process.

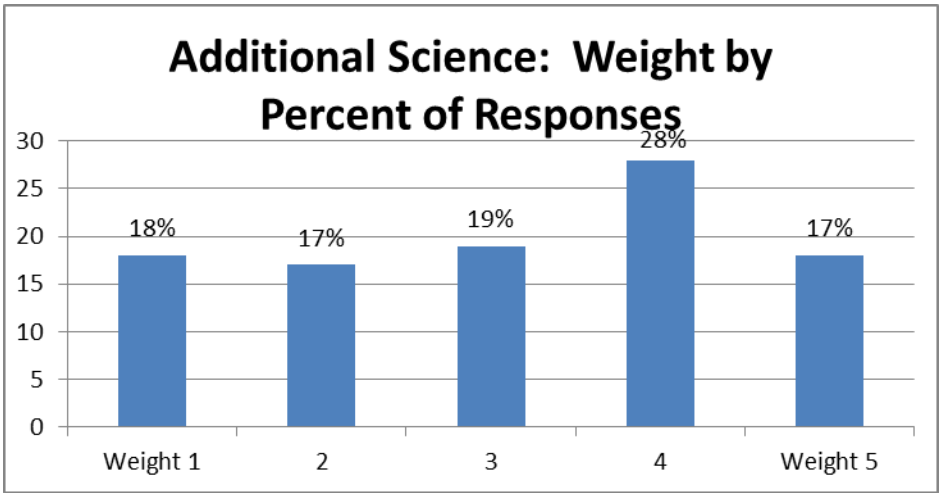

Figure 1.5.1: Percentage distribution of weights for the factor for the factor, "The need for additional scientific investigation."

Table 1.5.1: Percentage distribution of weights for the factor "The need for additional scientific investigation."

The Need for Additional Scientific Investigation									
Method Selected	Weights: Percent of Method Total							Median Weight	Ratio H/L (4+5)/(1+2+3)
	1	2	3	4	5	N/A	Don't Know		
Direct Discussions	20.7	13.8	22.1	24.8	15.9	0.7	2.1	3	0.7
Expert Review	12.8	20.5	11.5	32.1	19.2	1.3	2.6	4	1.1
More Science	15.9	12.2	20.7	30.5	15.9	1.2	3.7	3	1.0
Collaboration	20.7	17.1	20.7	25.6	12.2	3.7	0.0	3	0.6
Public	18.9	17.6	20.3	27.0	16.2	0.0	0.0	3	0.8
Adaptive Mg'mt	13.7	21.9	13.7	23.3	23.3	0.0	4.1	4	0.9
Mean	**17.1**	**17.2**	**18.2**	**27.2**	**17.1**	**1.1**	**2.1**		**0.9**

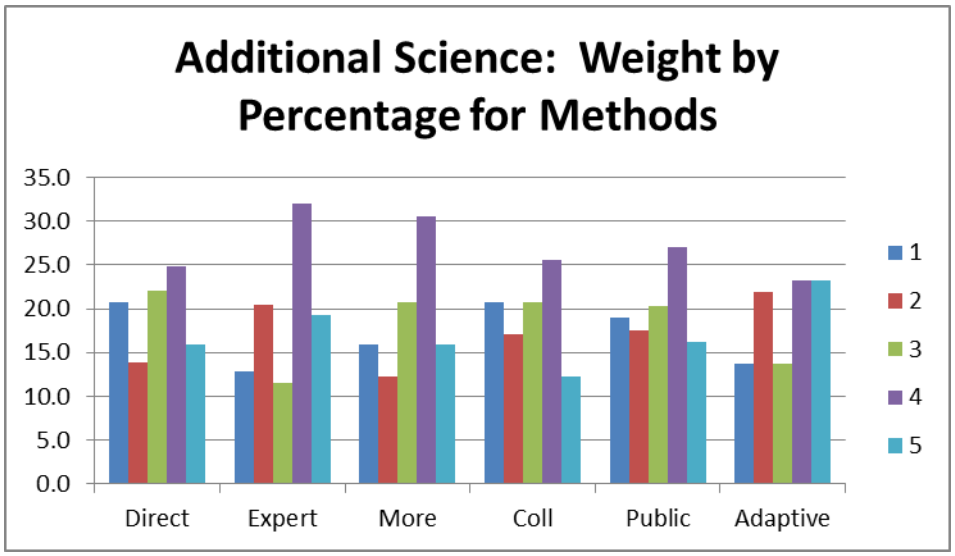

Figure 1.5.2: Frequency distributions for individual methods for the factor, "The need for additional scientific investigation."

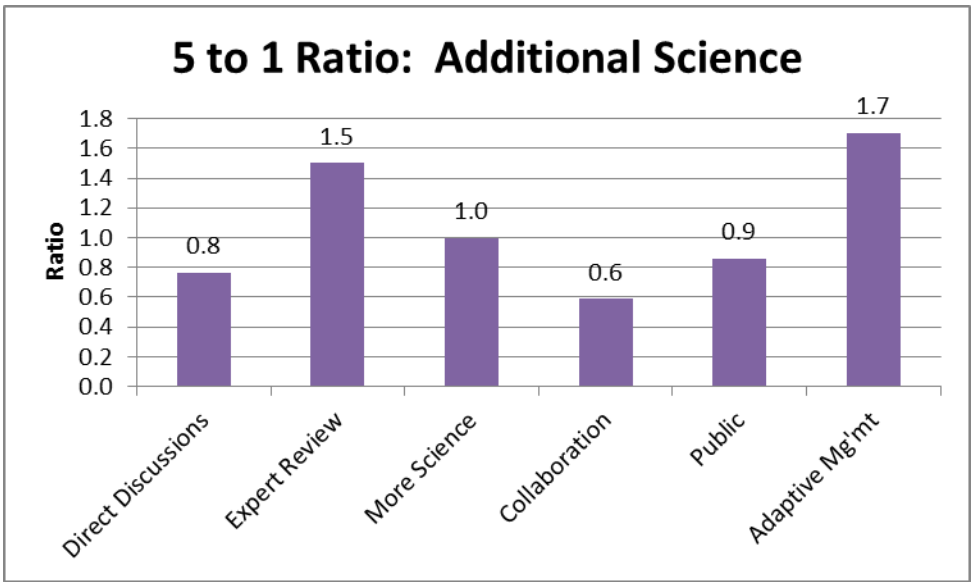

Figure 1.5.3: Ratio of 5 to 1 weights for the factor, "The need for additional scientific investigation."

Whether or not science should be the basis for the management decision

Some disputes over science are either mixtures of political and scientific conflicts or they are really political disputes in disguise. Such is the case when the so-called “hired-guns” or “dueling scientists” appear, each staking a scientific claim in line with the interests of the constituency they represent. Another variation on this theme takes the legalese form of “admitting no wrong doing” and “poking holes” in the hypotheses of other scientists-- without offering plausible alternate hypotheses regarding the issue at hand. Sometimes the political nature of these disputes can be unmasked by conducting more science, but it is just as likely that those benefitting from this approach will find yet other scientific issues to quibble about so long as it is in their interest to do so. Since this red herring tactic pops up very often in public water conflicts, we hypothesized this factor would be pronounced where public involvement processes were ongoing.

Figure 1.6.1 indicates that this ‘bottom-heavy” factor was of considerably less importance than most of the rest of the seven factors with an overall median weight of 3 and a high to low ratio of 0.60, below the 0.67 level of category equality. As predicted, this management factor figured most prominently when public involvement processes were utilized with a high-low ratio of 0.8 (Table 1.6.1). Predictably, it was also prominent for adaptive management (0.6), which is sometimes a politicized process, and where “more science” (0.7) was called for— the need for which might, in fact, be initiated by dueling scientists working in behalf of their constituencies (Table 1.6.1 and Figure 1.6.2). Again, interestingly, where collaborative processes and direct discussions were ongoing, this factor was of considerably less importance (0.5). One might speculate that when this approach was used the question as to how the decision would be made would be settled at the moment that the parties agreed to collaborate.

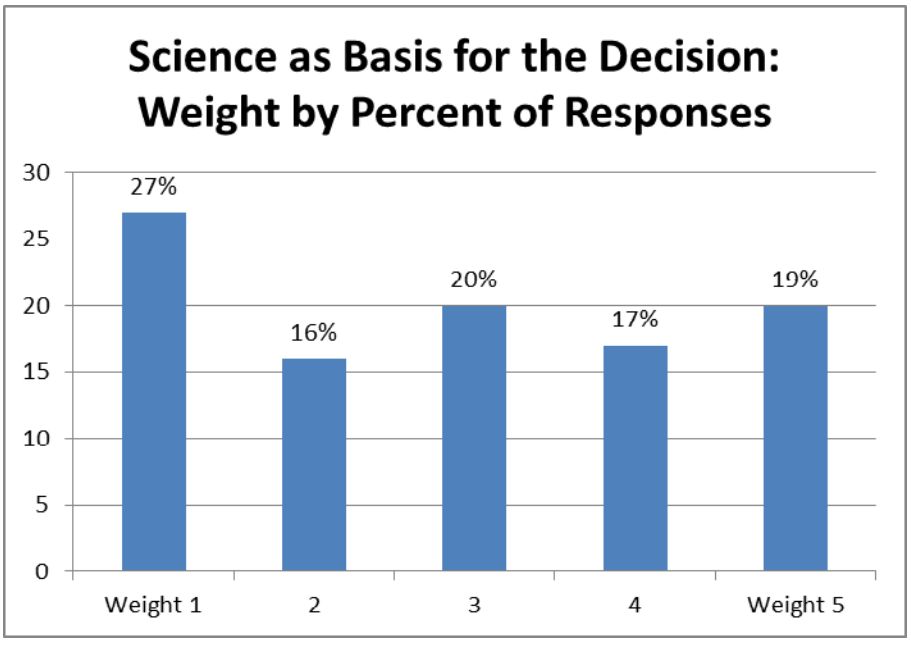

Figure 1.6.1: Percentage distribution of weights for the factor, "Whether or not science should be the basis for the management decision."

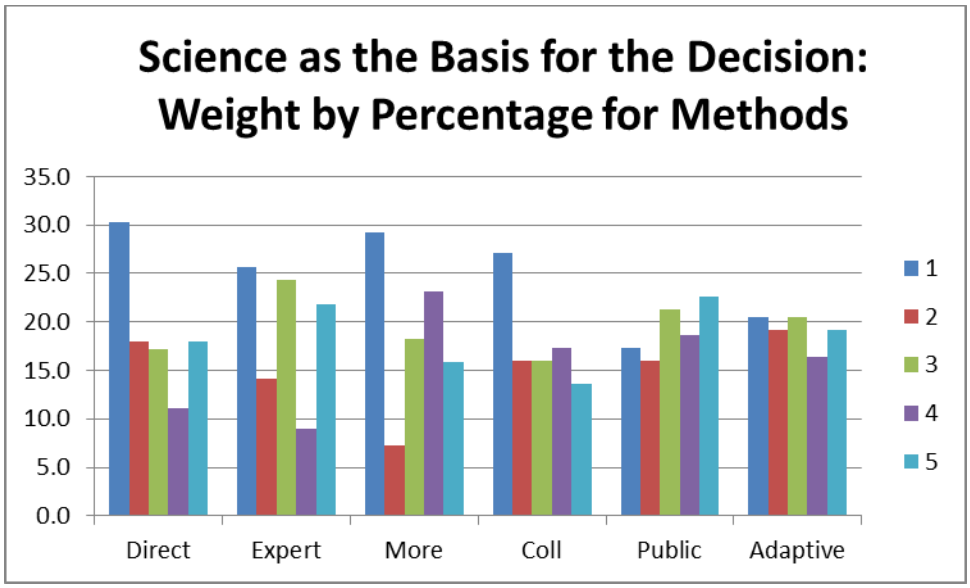

Figure 1.6.2: Frequency distributions for the factor, "Science as the Basis for the Decision."

Table 1.6.1: Percentage distribution of weights for the factor, "Whether or not science should be the basis for the management decision."

Whether or not science should be the basis for the management decision									
Method Selected	Weights: Percent of Method Total							Median Weight	Ratio H/L (4+5)/(1+2+3)
	1	2	3	4	5	N/A	Don't Know		
Direct Discussions	30.3	17.9	17.2	11.0	17.9	2.8	2.8	2	0.4
Expert Review	25.6	14.1	24.4	9.0	21.8	1.3	3.8	3	0.5
More Science	29.3	7.3	18.3	23.2	15.9	3.7	2.4	3	0.7
Collaboration	27.2	16.0	16.0	17.3	13.6	3.7	6.2	3	0.5
Public	17.3	16.0	21.3	18.7	22.7	2.7	1.3	3	0.8
Adaptive Mg'mt	20.5	19.2	20.5	16.4	19.2	1.4	2.7	3	0.6
Mean	**25.0**	**15.1**	**19.6**	**15.9**	**18.5**	**2.6**	**3.2**		**0.6**

Figure 1.6.3 shows the 5 to 1 ratios. Public outreach and adaptive management (and its partner, expert review) were again prominent. Again, collaborative processes shared the lowest position with more science.

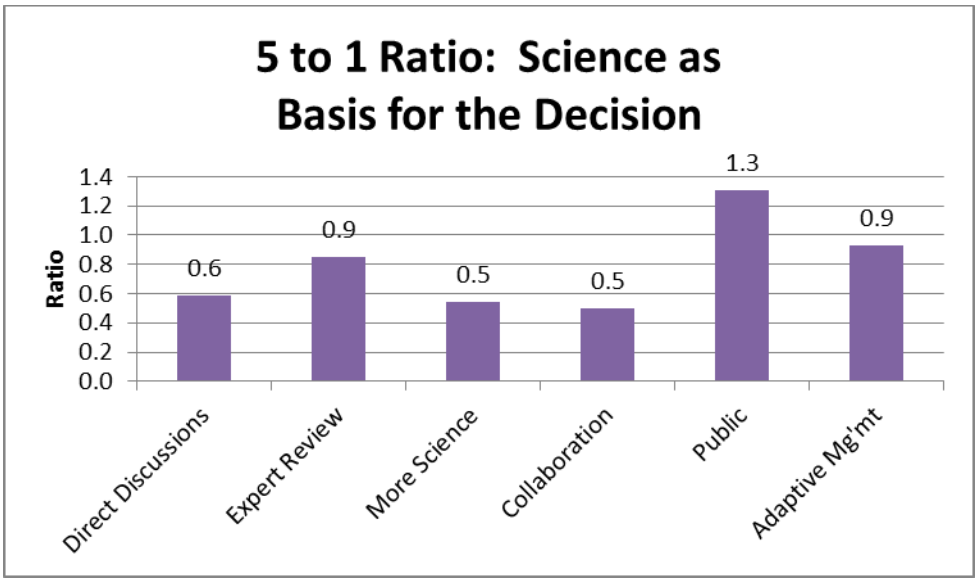

Figure 1.6.3: Frequency distributions for individual methods for the factor, "Whether or not science should be the basis of the management decision."

The qualifications of the scientists who produced the science

Reclamation focus groups studying disputes over water in a 2006 study revealed that the qualifications of scientists became an issue when (a. one or more scientists claimed to be *the* leader in his/her field and (b. when one discipline claimed supremacy over another one with respect to the scientific issue at hand. For instance, a fish biologist studying the demise of an endangered aquatic species may have claimed to have expertise superior to that of a wildlife ecologist. For the current survey it was hypothesized that this factor could become an issue irrespective of the dispute resolution method being used. Figure 1.7.1 indicated that this factor was the least important among the 7 examined, being extremely bottom-heavy and with median weights in the 2-3 range (median of 2, high to low ratio of 0.3) (Table 1.7.1). The bottom-heaviness was also pervasive across conflict resolution methods (Figure 1.7.2). Interestingly, again, where collaborative processes were in play, this factor least showed the least play (0.2 ratio).

All of the 5 to 1 ratios were well below unity, again reinforcing the conclusion that this issue was seldom in dispute, regardless of the dispute resolution method chosen. In this case, collaborative processes showed the second lowest ratio.

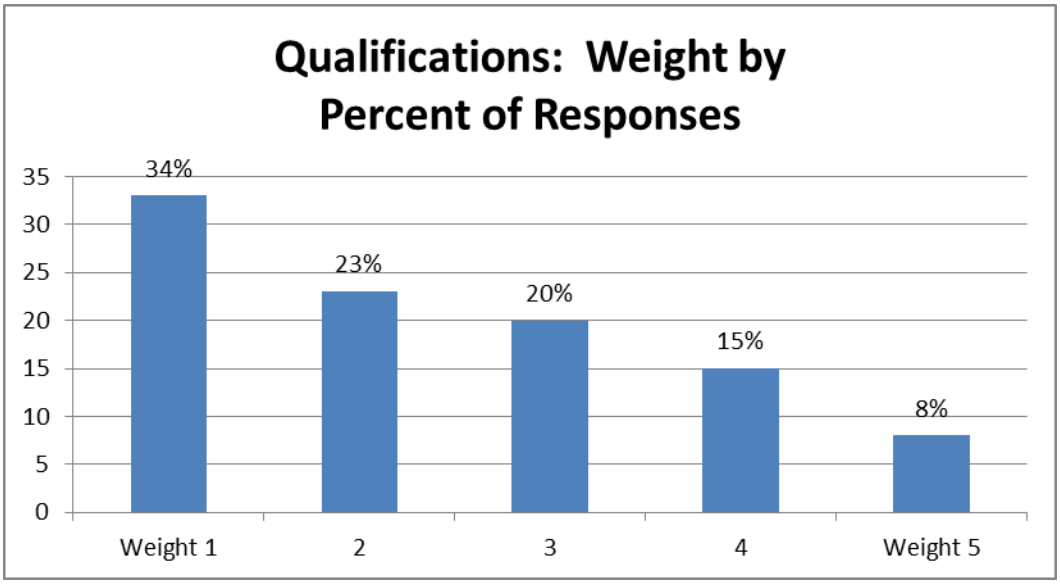

Figure 1.7.1: Percentage distribution of weights for the factor for the factor, "The qualifications of the scientists who produced the science."

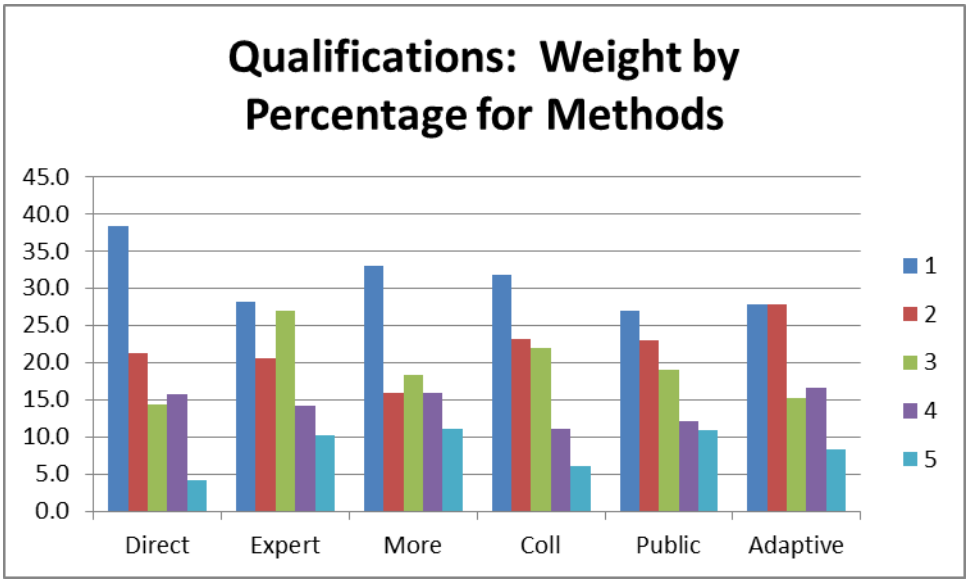

Figure 1.7.2: Frequency distributions for individual methods for the factor, "The qualifications of the scientists who produced the science."

Table 1.7.1: Percentage distribution of weights for the factor, "Qualifications of the scientists who produced the science."

The qualifications of the scientists who produced the science									
Method Selected	Weights: Percent of Method Total							Median Weight	Ratio H/L (4+5)/(1+2+3)
	1	2	3	4	5	N/A	Don't Know		
Direct Discussions	38.4	21.2	14.4	15.8	4.1	2.1	4.1	2	0.3
Expert Review	28.2	20.5	26.9	14.1	10.3	0.0	0.0	3	0.3
More Science	32.9	15.9	18.3	15.9	11.0	2.4	3.7	3	0.4
Collaboration	31.7	23.2	22.0	11.0	6.1	2.4	3.7	2	0.2
Public	27.0	23.0	18.9	12.2	10.8	5.4	2.7	3	0.3
Adaptive Mg'mt	27.8	27.8	15.3	16.7	8.3	4.2	0.0	2	0.4
Mean	**31.0**	**21.9**	**19.3**	**14.3**	**8.4**	**2.8**	**2.4**		**0.3**

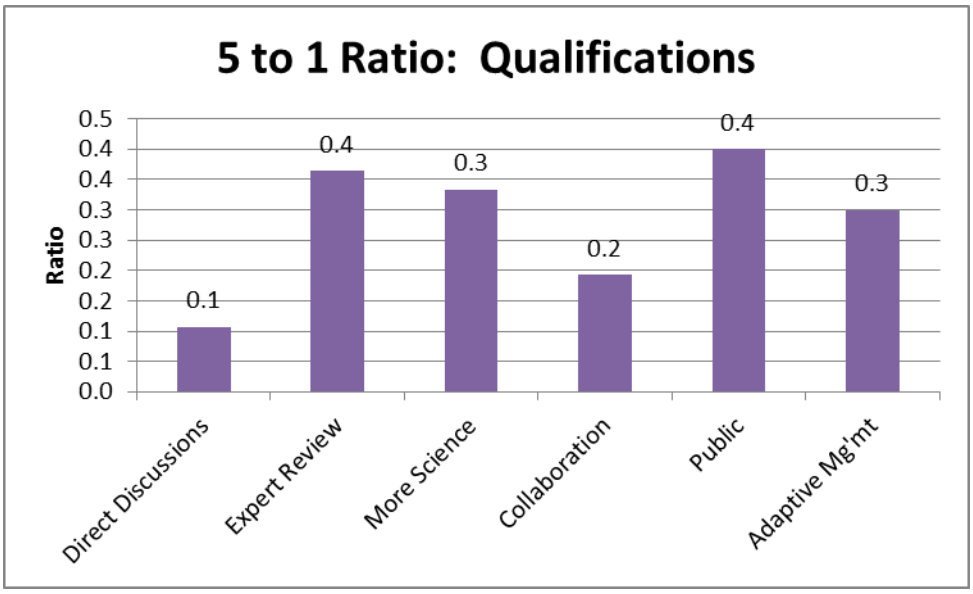

Figure 1.3.3: Ratio of 5 to 1 weights for the factor, "The qualifications of the scientists who produced the science."

Summary and Discussion: Contested Factors for the Seven Methods

This survey question sought to assess the importance of the following scientific factors (a. over all dispute resolution methods and (b. by individual dispute resolution method:

1. Whether or not the existing science addressed the critical issues
2. The quality of the data used
3. The inference(s) drawn from the science
4. The level of uncertainty in the science

5. The need for additional scientific investigation
6. Whether or not science should be the basis for the management decision
7. The qualifications of the scientists who produced the science

In interpreting the results, it is important to discuss how and why particular dispute resolutions methods might be chosen. We can by no means be certain about the extent to which any of seven factors listed in this section may or may not have been considered in making the actual choice of a dispute resolution method. Likewise, we cannot know when or for how long a particular issue was contested during the course the individual disputes over science. Choosing any method for resolving such a dispute is undoubtedly complicated by many factors-- such as familiarity with one method versus others, the availability of personnel trained to implement any particular method, and, not the least, since some of methods can be costly to implement, both in terms of time and money, access to funding. However, we can say that *"when a particular dispute resolution method was chosen, across respondents it was top or bottom heavy or evenly distributed, i.e. not very important, very important, or somewhere in between."*

As the data were interpreted, it was recognized that some of the dispute resolution methods were more operationally complex, and hence more costly in both time and effort, than others and that this fact could bear upon decisions to choose them. Direct discussions usually occur in an ad hoc manner, often just before a public meeting. Frequently, these are designed to seek out clarifications or to iron out minor differences. When substantial gaps in the science are found in these discussions, more complex and involved methods may come into play, such as conducting more science, or engaging in a collaborative study effort. Finally, in cases where still more complexity, uncertainty, and contentiousness is present, the parties may have recourse to a long term adaptive management effort or turn to expert review under the auspices of, for instance, the National Academy of Sciences. Questions arising from the public, and the consequent need for public outreach and education, can obviously occur at any level of complexity.

Table 1.8.1 summarizes the importance of each scientific factor over all dispute resolution methods. In other words it summarizes the first graphs appearing in each section. In rank order of importance, the factors were: the inferences drawn from the science (H/L ratio of 2.3, median weight 4), whether the existing science addressed the critical issues (1.5, 4), the level of uncertainty (1.4, 4), the quality of the data (1.1, 4), the need for additional science (0.8, 3), whether science should be the basis of the management decision, (0.6, 3), and, finally, the qualifications of the scientists (0.3, 2).

Table 1.8.1: Summary Table of Percent Distribution of Weights for Factors in Dispute in the Scientific Enterprise.

Question	Percent of Question Total Responses 1	2	3	4	5	Median Weight	Ratio H/L (4+5)/(1+2+3)
1. Existing Science	11	11	18	34	27	4	1.5
2. Data Quality	11	12	25	34	18	4	1.1
3. Inferences Drawn	3	7	20	37	32	4	2.3
4. Level of Uncertainty	7	11	24	37	21	4	1.4
5. Need for Additional Science	18	17	19	28	17	3	0.8
6. Science Basis for Mg'mt Decisior	27	16	20	17	19	3	0.6
7. Qualifications of Scientist(s)	34	23	20	15	8	2	0.3
Mean	**15.9**	**13.9**	**20.9**	**28.9**	**20.3**		**1.1**

Table 1.8.2: Summary of high to low ratios across factors and methods.

	Ratio of High to Low Weight Percentages for Methods					
Factor	**Direct**	**Expert**	**More Sci**	**Collab**	**Public**	**Adaptive**
1. Existing Science	1.2	2.7	1.8	1.0	1.4	1.5
2. Data Quality	0.9	1.0	1.3	1.2	1.3	0.9
3. Inferences Drawn	2.8	2.3	2.4	1.9	2.0	1.6
4. Level of Uncertainty	1.2	1.6	1.3	1.5	1.3	1.6
5. Need for Additional Science	0.7	1.1	1.0	0.6	0.8	0.9
6. Science Basis for Mg'mt Decision?	0.4	0.5	0.7	0.5	0.8	0.6
7. Qualifications of Scientist(s)	0.3	0.3	0.4	0.2	0.3	0.4
Sum	**7.5**	**9.5**	**8.9**	**6.9**	**7.9**	**7.5**
Mean	**1.1**	**1.4**	**1.3**	**1.0**	**1.1**	**1.1**

Turning to Table 1.8.2, overall the most complex methods, with the exception of collaborative learning, showed large high to low ratios when summed across the seven factors: expert review (total value of 9.5, mean of 1.4) and adaptive management (7.5, 1.1). In the middle level of complexity, "Reclamation conducts more science" scored highly (8.9, 1.3). Interestingly, the most "trouble free" method was collaborative learning with an overall sum across all factors of 6.9 and a mean of 1.0. Indeed, collaborative processes had the lowest ratio in 4 of the 7 factors and the second lowest for the other 3. This seems to suggest that Reclamation might find benefit in investing in collaborative processes, at least where these 7 factors are concerned.

Table 1.8.3: Summary of 5 to 1 ratios across factors and methods.

	Ratio of 5 to 1 Percentages for Methods					
Factor	**Direct**	**Expert**	**More Sci**	**Collab**	**Public**	**Adaptive**
1. Existing Science	2.1	2.4	3.4	1.2	2.3	4.4
2. Data Quality	1.3	1.3	2.0	2.0	2.0	1.1
3. Inferences Drawn	6.8	12.0	29.0	3.5	5.8	6.3
4. Level of Uncertainty	2.3	4.5	7.0	2.5	2.3	6.0
5. Need for Additional Science	0.8	1.5	1.0	0.6	0.9	1.7
6. Science Basis for Mg'mt Decision?	0.6	0.9	0.5	0.5	1.3	0.9
7. Qualifications of Scientist(s)	0.1	0.4	0.3	0.2	0.4	0.3
Sum	**14.0**	**23.0**	**43.2**	**10.5**	**15.0**	**20.7**
Mean	**2.0**	**3.3**	**6.2**	**1.5**	**2.1**	**3.0**

In Table 1.8.3, we see a somewhat different picture. More science, with its exceptionally high 5 to 1 value on inferences had the highest mean ratio overall at 6.2. It is likely, of course, that where inferences were in question, there might be automatic, "back-to-the-drawing-board" calls

for more science. Save that number, however, the more complex methods such as expert review and adaptive management scored highly. Interestingly, collaborative methods again scored the lowest mean ratio at 1.5, possibly indicating, again, that this approach had the potential at least of being the most trouble free overall.

This analysis indicates that, among the factors listed three stood out in Reclamation disputes over science: inference drawn from the science, whether the existing science addressed the critical issues, and the level of uncertainty. The agency might do well to conduct its studies with this in mind and consider possible mitigations in advance. One indicated mitigation that stood out here was collaborative processes which would include such activities as joint fact-finding, learning, and modelling.

Other contested factors

For some 72 conflicts over science in the survey, "other factors" were mentioned to be at issue. We developed five categories of these: *bias*, *budget*, *policy-legal*, *politics*, and what we have labeled "*other science*".

- *Bias* refers to an uncovered lack of independence manifest in a person key to the scientific enterprise.
- *Budget* refers to lack of funding for some aspect of the undertaking.
- The *policy-law* category indicates legal or policy impacts on the science.
- *Politics* refers to internal or external political forces impinging upon the scientific enterprise.
- And "*other science*" is an "*other contested factor*" that refers to a variety of purely scientific, i.e. unaffected by politics, law, policy, bias, or budget issues that emerged during the dispute over science. Figures 1.9.1 and 1.9.2 and Table 1.9.1 show the frequencies and percentages of these other factors.

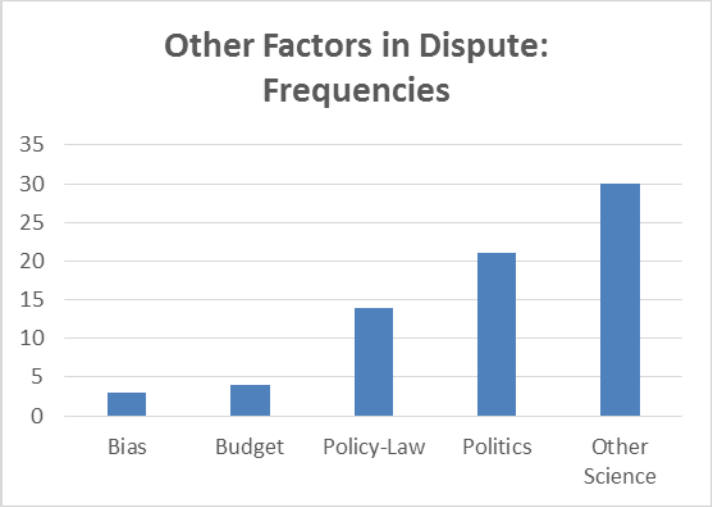

Figure 1.9.1: Frequency distribution of other factors in dispute.

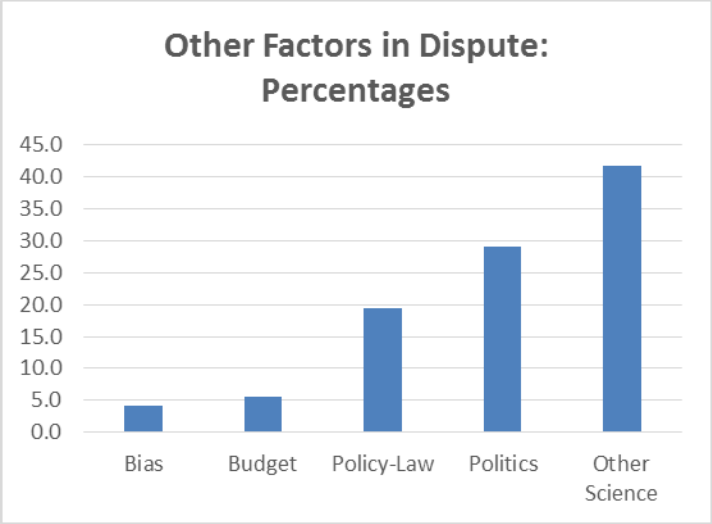

Figure 1.9.2: Percentage distribution of other factors in dispute.

Table 1.9.2: Frequency and percentage distribution of other factors in dispute.

Other Factors Bearing on the Dispute		
Factor	**Frequency**	**Percentage**
Bias	3	4.2
Budget	4	5.6
Policy-Law	14	19.4
Politics	21	29.2
Other Science	30	41.7

Bias. In three instances there were questions about bias. One respondent believed that the expert who was called in to review the science was not independent. In a second, it was reported that, "At issue here was not so much the qualifications of the scientists as their personal bias and lack of understanding of Reclamation authorities and operations." And in the last case, the respondent noted the presence of a "(p)ersonal agenda, bias, opinions, belief. Individuals exceeding their positional authority, expressing their personal opinions, etc."

Budget. Budget issues were also said to be at the heart of some disputes over science and could impinge on the conduct of the scientific enterprise, i.e. the management of the science. In one case, there was concern over the cost-effectiveness of the field techniques. In another, concern was raised about who benefitted most from the jointly funded research effort. Additional concerns centered on questions of whether or not adequate testing was funded pre- and post-treatment. In a final case, there was frustration expressed that, for a particular habitat restoration effort, some stakeholders were only concerned about holding down costs. Creating "usable habitat costs more than the bare minimum," the respondent lamented.

Policy/Legal. Sometimes policy and/or legal issues impinged upon the science. The most frequent issue here was the role that other agencies (governmental and not) played or were allowed to play in the scientific deliberations. One respondent noted that an outside agency, along with its lawyers and consultants, was allowed to "actively participate in (and partially control) the ongoing ESA consultation…" In another case, the respondent noted that the issue was, "Whether Reclamation would agree to the largess of unscientific assumptions proposed by project proponents." In another case, there was concern about "what if anything the BOR has done to support the BOR (Bureau of Reclamation) findings against" another agency's opinion. In still another case there was concern about the scrutiny Congress was placing on Federal programs, making it "imperative that the best, most effective science is used in implementing the program." Regulatory agencies were also mentioned. One respondent expressed concern that arbitrary "habitat remediation ratios imposed by individuals with regulatory oversight agencies are costing tax payers millions…"

There were several other issues that were mentioned with respect to the interface of policy and/or legal issues and agency management decision-making. In one case there was an issue "about what management changes to make", given the results of a study. Likewise, in another instance there were questions about processes for distributing information about a potential health issue to a particular public segment at risk.

Politics. Another type of conflict mentioned in the "Other" section, involved politics. The first sub-type within this category centered on the perceived view among some respondents that politics at times superseded science. For instance, one person wrote, "The "independent" reviewers were not familiar with the material, and we were given a political agenda to meet." Two respondents felt there was, in their eyes, insufficient support of scientific findings amongst managers. For instance, one wrote, "Management's decision to NOT support the research findings appeared to be based more on politics rather than the science presented and finding documented." In another case the politics was personal: "Personal agendas, unable to admit errors or wrong doings in judgment, trying to save face, etc."

A second subtype within the political category revolved around the expectations of outside entities. For instance, "Indian tribes wished to be decision-makers, feeling that agency scientists were biased toward scientific research and solutions. Tribes also wished to limit public or researchers' access to data generated from studies. In another case, an external agency was said to be "expecting seeding success (percent coverage) to be higher that what is usually present naturally." Still another said an outside agency was trying to take control of a program. "We were trying to work together while one entity sought control over the program via the courts…"

A third sub-type concerned political disputes among scientists and engineers. One respondent stated the opinion that, "Reclamation adaptive management efforts (are) often led by unqualified engineers. They do not understand science. The goal is not actual adaptive management and fish recovery, it is simply delay the process, spend money, and accomplish nothing." Another wrote, "Engineers claiming to have all the answers in restoration and habitat management, and forging ahead with the existing methods without data, yet challenging the biologists to have data before they will change their practices—double standard and using science as a weapon to change vs. adapting or trying out new methods. Allowing politics to drive decisions instead of using existing data on issues such as grazing, recreation, etc. to drive habitat management decisions."

A fourth political sub-type centered on the expectations of the public and stakeholders. One respondent wrote, "The general consensus of the public is that there is a lack of understanding of the potential impacts that could be caused by allowing water transfers." In another instance, "The water interests…were in denial that water resource development had caused adverse consequences to endangered bird habitat." Or again, "Scientific disputes were secondary to policy positions of parties concerned primarily with renewal of concession contracts. Natural positions of parties concerned primarily with renewal of concession contracts."

Other Science. The final types of disputes found in the "other" category involved those about the science itself, namely, how the analyses, classifications, measurements, etc. were conducted, how complete or useful the data were, or, at a higher level, how the whole scientific enterprise was conducted or managed. These "other" issues were categorized as "other science". There were 30 entries in this category.

Of these 30, 6 were concerned with analytic issues. They included:

- "determining the factors and probabilities of dam failure due to specific causes."
- "Resolution or robustness of (the) analysis methodology."
- "Were juvenal salmonids protected in a manmade tail race?"
- "…determine whether or not a management strategy to increase certain flows would cause negative effects to other water users."
- "Flow velocity and turbulence for fish passage."
- The connection between water quality and the cyclical life pattern of other species.

The commonality amongst these entries was the attempt to determine or attribute *causality*, i.e. determining if, how, or to what extent X causes Y.

One of the 30 entries mentioned concerned classification. The respondent questions whether "the proper code was being applied to the condition being studied."

Three of 30 concerned the type or sufficiency of the scientific expertise or technology brought to bear on the problem at hand. "Species specialists had insufficient knowledge of hydrology and facility operation limitations. Other experts could have helped if the parties would agree up front to accept the results of their analyses." Relatedly, another respondent wrote, "Each scientist has their own favorite method from which they will not be swayed, even in the presence of overwhelming evidence suggesting another method is superior." Finally, "the level and the quality of the peer review" was in question for another respondent. In sum, in these cases, what was at issue was the range of the knowledge of the scientists and engineers, their willingness to apply different methods, and the diligence with which existing expertise was applied.

Data issues consumed 5 of the 30 "other science" entries. Of these 5, 4 pertained to data completeness. One reported that there was a "Lack of data to base a decision." Another noted that, "Initial data was incomplete" leading to a possibly erroneous inference. Still another reported that the, "Data was the best available at the time; now better data is available." Or again,

"There was incomplete scientific data…" The respondent went on to state, "With Bi-Ops, RODs, and EISs in place these days, there needs to be an understanding by those parties that do not necessarily operate by these regulations that data needs to be collected, organized and presented, unbiasedly, to be able to provide an informed justification for potentially altering an operating regulation." One other respondent reported that some parties used data or the lack of data to obstruct. "Basic biological concepts such as the importance of biological diversity are met with a 'show me the data' response."

Of the 30 "other science" issues in question, one centered on *design* concerns of stakeholders and regulators. There was an issue around the compatibility of the design of a structure with natural river processes and the consequent potential impacts on the local fish population.

Five more issues (16.7%) were devoted to the interpretation of the science:

- Whether a panel of scientists had been too conservative in its assessment of risk,
- "How the data was or was not collected. Interpretation of the data and what it meant in an institutional/political context."
- "…there may have been science to justify the issues but the probability was very slim."
- "Not conflicts among biologists, but the biology did not align with the hydrology."
- "Likelihood that additional study would significantly alter the then current scientific understanding of the situation."

Of 30 mentions, 6 (20%) "other science" issues were concerned with the management of the scientific enterprise. This category touches such issues as the "lack of collaboration in designing the study approach and analyzing the data collected", whether or not peer review was conducted, overall methods, collaboration amongst agencies, collaboration amongst scientists, and the actual or perceived requirements for peer-reviewed publication.

Finally, 2 of 30 (10%) "other science" responses were concerned with measurement issues. These were concerned with (a. the accurate quantification of community economic impacts, and (b. the applicability of an accepted protocol.

Summary: "Other" Contested Factors

Besides the seven factors listed at the beginning of this paper, survey respondents listed out what they considered to be five additional categories of contested factors: Bias, Budget, Policy-Law, Politics, and Other Science. Bias was concerned with a lack of independence in process or in personnel conducting or interpreting the science. Budget was concerned with adequacy of funding to successfully execute the scientific enterprise. Policy-law was concerned with the way policy and/or legal considerations could impinge of the execution or interpretation of the science. Politics concerned the way internal or external factions could sway the science. And Other Science spoke about how simple differences over scientific process could impinge upon the science. Taken together, these offer new avenues of inquiry with respect to management of disputes over science. Reclamation scientists and engineers may want to be mindful of these

factors going forward and take appropriate steps to avert them. Again, as hinted in the previous section, inclusive collaborative processes may be a useful approach for avoiding or mitigating bias, legal, political, and scientific pitfalls because, with the full participation of parties, and their scientists, which collaboration entails, these issues must be confronted and managed at each stage of the scientific process.

Appendix: Survey Questions

Q 1 Introduction to the survey
Q 2 During your employment with Reclamation, have you been involved in one or more disputes over science that included outside agencies or stakeholder organizations AND that were sufficiently serious to impede a water resource management decision?
Hide
Question type: Pick one or 'other'
Answer options:
Yes
No

Q 3 In these disputes over science, have you been involved in the use of any of the following methods to help resolve the conflict? Direct Discussions Between or Among Scientists: Processes that bring technical experts involved in a science dispute together to identify areas of agreement and disagreement, data needs and gaps, scientific protocols, and potential approaches to resolving technical disputes. Independent Expert Review: One or more outside experts review the disputed science and reach conclusions regarding the weight of the evidence and the adequacy of the science. Reclamation Undertakes More Science and Analysis Independently of the Other Parties: Reclamation undertakes additional studies or analyses in an effort to address concerns or conflicts. Active Collaboration in Research and Analysis: The outside parties involved in the dispute engage with Reclamation in collaborative science, jointly undertaking scientific training, hypothesis development, data collection, model building, or data analysis. Public Education, Data Sharing, and Results Dissemination: Outreach activities designed to inform the public and stakeholders about the technical issues, existing data and science, and Reclamation's analysis of the information. Adaptive Management: A planned program of experimentation and adaptive decision-making based on scientific feedback used to address uncertainties or differences over science, and the management of water and related resources. Other (you will be asked to briefly describe how this method differs from those listed above).

We would like to ask about your experience with these methods one at a time, covering up to 3 of these methods at the most. From the list please select the method with which you have the most experience, i.e., you were directly involved.

Question type: Pick one or 'other'
Answer options:
Direct Discussions Among Scientists Independent Expert Review Reclamation Undertakes More Science and Analysis Independently of the Other Parties Active Collaboration in Research and Analysis Public Education, Data Sharing, and Results Dissemination Adaptive Management Other (please describe how this method differs from those listed above):

Q 5 Having identified the method with which you have the most experience, now focus on the most recent dispute over science in which that method was used. Briefly list the scientific issues that were under dispute below:

Q 6 Please indicate the extent to which the following factors were contested in this most RECENT dispute over science:
Scale: Not Contested 1 - 2 - 3 - 4 - Highly Contested - 5

Answer options:
Whether or not the existing science addressed the critical issues:
The quality of the data used:
The inference(s) drawn from the science:
The level of uncertainty in the science:
The need for additional scientific investigation:
Whether or not science should be the basis for the management decision:
The qualifications of the scientists who produced the science:

Data Sets that support the final report: This project was an anonymous survey conducted with the assistance of the U.S. Geological survey. The data are confidential and not available for circulation.

Share Drive folder name and path where data are stored: This project was an anonymous survey conducted with the assistance of the U.S. Geological survey. The data are confidential and not available for circulation.

Point of Contact name, email and phone: Douglas Clark, drclark@usbr.gov, 303-445-2271

Short description of the data: (types of information, principal locations collected, general time period of collection, predominant files types, unusual file types.) This project was an anonymous survey conducted with the assistance of the U.S. Geological survey. The data are confidential and not available for circulation. The data exist as tabular spreadsheets. The survey was conducted across Reclamation in the year 2011.

Keywords: conflict management, water conflict management, science conflict.

Approximate total size of all files: (folder size): 150 Megabytes