

Proposed Approach to Pallid Sturgeon Decision Support

August 17, 2018

Background

In September 2017, the Governance Committee articulated a need to improve its ability to make informed choices about pallid sturgeon in the Second Increment. The following three priorities were defined for the Programs' activities during the First Increment Extension:

1. Conduct research to address how pallid sturgeon use the Platte:
 - Define what constitutes pallid habitat in the Platte
 - When, where, and how are pallids using specific physical habitat features?
 - Define unfavorable hydrologic conditions for pallid sturgeon (e.g., that lead to mortality events)
2. Improve understanding of the Program's effect on pallids; evaluate hydrology-habitat-use links
 - Do we need to improve our tools to understand Program effects? (Decision point)
 - Are existing Program management actions having any effects?
3. Evaluate a broader suite of management actions that the Program could take or support to enhance conditions for the pallid sturgeon in the Second Increment.
 - Identify and evaluate the relative merits of a broad suite of potential actions in consideration of the many (Program and non-Program) influences on pallids.

Context and Starting Assumptions

Some starting assumptions:

- In setting the above priorities, the GC emphasized the need to understand the role that the Lower Platte plays in recovery of pallid sturgeon, independent of the Program's ability to influence that role (e.g., through hydrologic change). Priority was placed on understanding use of the Platte by spawning adults.
- What's currently known about that role is captured in the impact pathway database developed by the Pallid Sturgeon Task Group (PSTG), and in the recent EDO white paper.
- Both of those compilations suggest that there are significant uncertainties about (a) when and where pallid sturgeon are spawning in the Lower Platte, (b) what environmental factors they are seeking or avoiding in those locations, and (c) whether spawning leads to recruitment.
- While the only management actions currently available to the Program involve water releases, it is conceivable that additional management actions (e.g., construction or acquisition of sturgeon rearing habitat) could be available in the Second Increment.
- In addition to small lingering uncertainties about the ways in which existing management actions (e.g., water releases up to the existing constraints) affect pallids, there are greater uncertainties about the degree to which these other actions could help achieve the Program's objectives related to pallids.
- The GC expressed a desire to be in a better position to choose among management approaches for pallids at the start of the Second Increment, which will require an understanding of *both* (1) how pallid sturgeon use the Platte, *and* (2) how the Program can affect those specific uses in the Second Increment of the Program (within whatever new constraints the Program has at that point).
- To prepare for that decision, it's helpful to look ahead and forecast what information the GC will need to best inform that choice. Below is the shell of a possible consequence table, showing some general categories of actions and the likely decision objectives that would be used to evaluate them (e.g., how actions will affect sturgeon, how they will affect other target species given a limited water budget, how much they will cost, etc.).

	Flow releases	Spawning Habitat construction / protection	Rearing Habitat construction / protection	Others...
Support sturgeon recovery				
Effect on other target species				
Cost				

- The current state of knowledge about how sturgeon use the Platte is not adequate to inform the development of more specific actions within these broad categories or to inform deliberations about the implications of those options on relevant objectives. Improving understanding of how pallids use the Platte will help to identify a range of options that may be considered in Second Increment planning and negotiations.
- Before a decision can be made about which management actions to pursue for pallid sturgeon, a separate decision needs to be made about whether and how to fill the specific knowledge gaps that currently hinder that decision; this requires carefully defining those uncertainties, considering alternative methods to address them, and evaluating the relative merits of those methods in a qualitative value-of-information framework.

Decisions to be made

Two separate but linked decisions are key to making progress toward a clear approach on pallid sturgeon.

The 2030 Decision: *What management actions should the Program undertake to best fulfill its obligations to pallid sturgeon in the Program's Second Increment?*

This decision requires addressing the following questions:

1. What are the Program's objectives related to pallid sturgeon?
2. What is the range of possible management actions available to the Program to support pallid sturgeon?
3. How might various actions impact pallid sturgeon and other Program priorities?

Program objectives (1) will be informed at the time by, among other things, new or continued responsibilities to pallid sturgeon, which could conceivably be influenced by the role that the Platte plays in the wider recovery of pallid sturgeon. Possible *management actions* (2) will be informed by improved understanding of the role the Platte plays in sturgeon recovery and will also become more clear at the time as the parameters of the Second Increment are negotiated between parties. *Consequences* (3) are in part informed by (2) but are also determined by how and when (in the year) pallid sturgeon use the Lower Platte.

The 2019 Decision: *What methods of reducing uncertainty should the Program pursue during the Extension to (a) better understand the role of the Platte in pallid recovery and (b) inform the connection between potential management alternatives and likely consequences on pallids?*

This decision requires addressing the following questions:

1. What specific uncertainties currently hinder the Program's ability to understand the full range of possible management actions, and to understand the connection between management actions and sturgeon outcomes,
2. To what degree will resolving these uncertainties provide (a) a fulsome picture of the role that the Platte plays for sturgeon, and (b) expected outcomes of management actions,
3. To what degree will those specific uncertainties be reduced through various research actions (e.g., field studies, modeling, expert judgment), and
4. What is the cost (broadly defined) of reducing those uncertainties?

Structuring the 2019 Decision

To address the four questions above, three main tasks are proposed: 1) Clarify the context, process and criteria for evaluating actions to reduce uncertainties, 2) Characterize uncertainties and research options, and 3) evaluate and select research actions. Figure 1 provides an overview of the process.

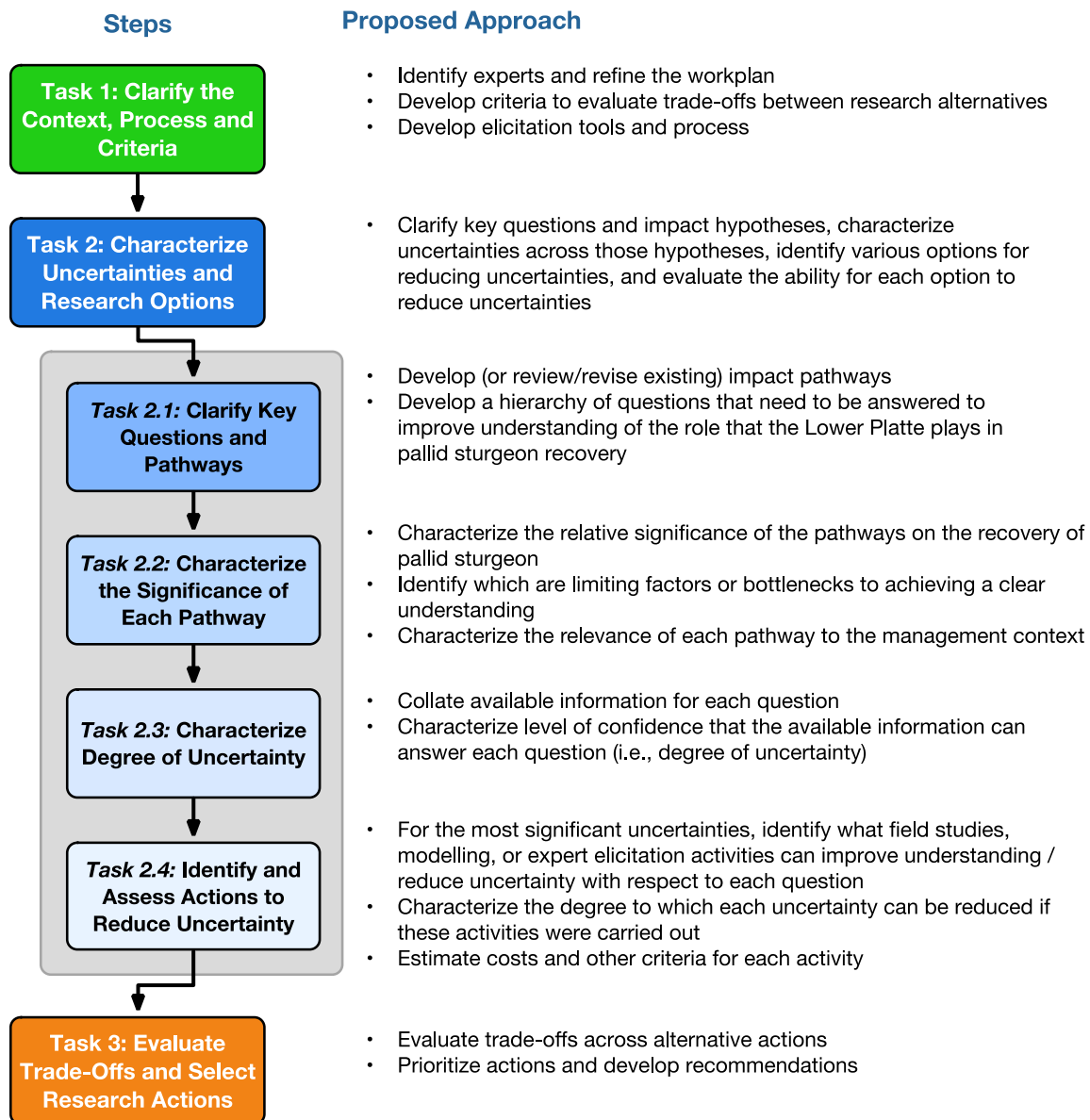


Figure 1. Overview of a structure for developing and evaluating alternatives for the 2019 decision.

Task 1: Context, Process and Criteria

Task 1.1 Identify Experts and Refine the Work Plan

The 2019 Decision is fundamentally a question about how to best use Program resources to design a research program (broadly defined) focused on understanding the role that the Platte plays for sturgeon, with the ultimate aim of providing stronger rationales for Program management decisions in the Second Increment. The process will rely on expert judgment. Upon approval, the first task will be to identify and confirm the availability of a small set of experts, establish a timeline and refine the work plan.

Experts from outside the Program will be selected primarily from the community of pallid sturgeon researchers on the Platte and Missouri; other experts may be considered if identified and available. Experts will be selected according to the following general criteria:

- Direct knowledge of and experience with pallid sturgeon ecology and associated subject matter areas;
- Strong familiarity with relevant literature, studies, and data sets, from both the Platte and Missouri Rivers;
- Experience in the characterization of uncertainty and the value of information;
- Expertise recognized by GC, TAC and ISAC members;
- No direct conflict of interest;
- To the extent possible, representation from a diversity of disciplines and/or institutions is desirable to ensure a range of perspectives.

Task 1.2 Develop Evaluation Criteria

As with any structured decision, clear criteria are required to guide evaluation and deliberation of the trade-offs that alternative research programs may present. These criteria may include degree of uncertainty reduction, cost, and timeliness of results. Compass will work with the EDO and the PSTG to develop draft criteria that the GC can use to compare and choose among alternative research portfolios.

Task 1.3 Develop Elicitation Tools and Process

This step involves developing tools to facilitate the development of impact pathway diagrams and associated information databases, the elicitation of expert judgment, the evaluation of systems-level uncertainty, and the prioritization of monitoring programs to reduce uncertainty. Compass has existing tools that can be readily customized for this project. Many of these tools are online to allow easier collaboration and user interaction. We will develop context-specific expert elicitation protocols for remote and in-person use.

Task 2: Characterize Uncertainties and Research Options

Once the context and criteria are defined, a structured process will help to develop research options that directly target priorities and provide the best return on investment of research effort.

Task 2.1: Clarify Key Questions

This step involves the development of a nested set of key questions, where the at top of the hierarchy is the big question “*What role does the Lower Platte play in the recovery of pallid sturgeon?*”, and subsequent levels address components of that broad question in increasing detail. These lower-level questions should be specific enough to address directly through empirical data, modelling, or expert judgment. In addition, in the development of this question hierarchy, it should be clear how understanding sets of lower-level questions “roll up” to informing understanding of high-level questions. For example, “*Does spawning occur in the Lower Platte and/or Elkhorn River?*” and “*If spawning does occur in the Lower Platte system, does it lead to recruitment?*” may be two sub-questions that inform an understanding of the role of the Platte for sturgeon. Part of the result of this step may look like the hierarchy in Table 1, below:

Table 1. Illustrative question hierarchy.

<i>What role does the Lower Platte play in the recovery of pallid sturgeon?</i>	
1. Does spawning occur in the Lower Platte and/or the Elkhorn River?	
1.1	Do physical habitat characteristics limit spawning occurrence in the Lower Platte/Elkhorn?
1.1.1	What physical habitat features do spawning adults use/avoid in the Lower Platte/Elkhorn?
1.1.2	Is the quantity of habitat available for spawning sufficient?
1.1.3	Is the quality of habitat available for spawning sufficient?

1.2	Do hydrologic conditions limit spawning occurrence in the Platte/Elkhorn?
1.2.1	What hydrologic conditions do spawning adults use/avoid in the Platte/Elkhorn?
1.2.2	Do existing hydrologic conditions limit access to physical habitats for spawning?
2. Does spawning in the Lower Platte and Elkhorn River lead to recruitment?	
2.1	Does availability of specific physical habitats (e.g., interception/rearing habitat) limit spawning success in the Lower Platte/Elkhorn?
2.1.1	Do these habitats exist in the Lower Platte/Elkhorn?
2.1	Does availability of specific hydrologic conditions limit spawning success in the Lower Platte/Elkhorn?
2.2.1	Does drift speed/length in the Lower Platte/Elkhorn support successful spawning in the Lower Platte/Elkhorn?

Impact pathway models will be created (or revised from existing versions) to inform the articulation of these questions. This process involves identifying all of the factors that contribute to the broader question of the role the Platte River plays in pallid recovery, and organizing those factors visually to indicate how they influence the pallid recovery.

The question hierarchy and impact pathway models will form the basis of a structured approach (furthered in Tasks 2.2 to 3) by which each question is evaluated to understand what information is available, what are key uncertainties and how they might be reduced, and how actions should be prioritized to reduce uncertainty for the most critical questions.

This process will lean heavily on work done to-date by the PSTG and the EDO to clarify impact hypotheses and to articulate key outstanding questions related to pallid sturgeon use of the Platte. To ensure coherence with the broader research effort on pallid sturgeon and avoid unnecessary duplication of effort, these revised products will receive additional review and input from a group of outside experts. The result will be a complete hierarchy of key questions and associated hypotheses and a revised impact pathway diagram describing the role that the Platte plays for pallid sturgeon. This task will be performed remotely, and any large group meetings could be easily done by teleconference.

Task 2.2: Characterize the Significance of Each Pathway

Once questions and pathways are established, the next step involves characterizing the relative significance of these pathways. Separately, experts will evaluate the strength of the influence of the pathway on recovery, and the relevance of each question to the broader management context.

The execution of this task will be grouped with Task 2.3 and 2.4. It will involve a facilitated process with outside experts that will follow best practices in elicitation of expert judgments. This includes the use of a modified Delphi approach, including:

- An initial kick-off teleconference to orient the experts to the context and details of the assignment.
- An individual remote elicitation, where experts provide responses to a combination of phone and on-line questions. Results will be synthesized, and a summary document will be circulated to the experts for review.
- A face-to-face workshop where experts engage in structured dialogue about assumptions and rationales, key areas of agreement and difference, approaches to aggregation, and key messages and next steps.
- Follow-up individual remote elicitation (by phone or online) to provide experts an opportunity to revise judgments and / or provide final input on findings.

Research has shown that this approach best leverages the benefits of group discussion and learning while avoiding common pitfalls such as *anchoring* and *groupthink*. The outcome of this process would be a significance rating for each question and impact pathway.

Task 2.3: Characterize Degree of Uncertainty

This step requires two sub-tasks. The first is compiling relevant studies and information, and like Task 2.1, this process will rely heavily on work done by the PSTG and the EDO currently captured in the impact pathway database and the EDO white paper. The second task is to provide an overall judgment, based on the weight of available evidence, of the degree of uncertainty (or conversely, confidence) for each hypothesis or impact pathway. Depending on the total number of hypotheses and impact pathways, this step may prioritize judgments of uncertainty on only the most important hypotheses as determined in Task 2.2.

This task will be grouped with Task 2.2 and 2.4. It will involve a facilitated process with outside experts, including both remote and in-person workshop, as described under Task 2.1 above.

Task 2.4: Identify and Characterize Options to Reduce Uncertainty

The next step involves (a) identifying field studies, modelling, and/or expert elicitation activities that can reduce or better characterize existing uncertainty, and then (b) assessing the degree to which combinations (or portfolios) of these activities could reduce uncertainty. This assessment provides an understanding of the effectiveness of alternative research portfolios in lending insight into the high-level uncertainties about the role of the Platte. Associated estimates of costs, time requirements, and other relevant implications from each activity will then be evaluated to enable an assessment of trade-offs in Task 3.

Compass will facilitate the initial identification of potential research actions and development of alternative research portfolios with the EDO using a portfolio builder tool. Experts will be asked (in an in-person workshop, grouped with Task 2.2 and 2.3) to identify additional actions and finalize portfolios. After the workshop, actions and portfolios will be refined by Compass/EDO. Remote (on-line/teleconference) tools and methods may be used to elicit judgments from experts about the relative performance of some of the options/portfolios in terms of uncertainty reduction, costs, and other evaluation criteria. The outcome of this step will be a characterization of the expected outcomes of several monitoring and study design approaches, akin to the options provided by the EDO at the end of the recent white paper.

Table 2 illustrates hypothetical outcomes from steps 2.1 through 2.4, including the significance of each question, a summary of available information, an assessment of uncertainty, and an assessment of the degree to which various research options are able to reduce uncertainties. Note that the scales used in this example are simplistic and are for illustrative purposes only. In practice, we will develop refined scales with expert input.

Table 2. Illustrative question hierarchy table with a summary of available information, and expert derived ratings for significance, degree of uncertainty, and the degree to which research options can reduce uncertainties.

What role does the Lower Platte play in the recovery of pallid sturgeon?								
Question		Significance	Available Information	Uncertainty	Ability to Reduce Uncertainty			
					Alt 1	Alt 2	Alt 3	Alt 4
1. Does spawning occur in the Lower Platte and/or the Elkhorn River?		High	Study A, B	High	M	H	X	X
1.1	Do physical habitat characteristics limit spawning occurrence in the Lower Platte/Elkhorn?	High	---	Very High	X	X	H	M
1.1.1	What physical habitat features do spawning adults use/avoid in the Lower Platte/Elkhorn?	Very High	Study A, C, D, E, F	Low	L	X	X	M
1.1.2	Is the quantity of habitat available for spawning sufficient?	High	Study G, H, I	Moderate	H	H	X	L
1.1.3	Is the quality of habitat available for spawning sufficient?	Low	---	Very High	H	X	M	X

Task 3: Evaluation and Selection

With a clear understanding of key questions, uncertainties, and options for reducing the most important uncertainties, the next step involves evaluating trade-offs across alternative research portfolios and prioritizing actions aimed at improving understanding of the role the Platte River plays in the recovery of pallid sturgeon.

This step will require a facilitated workshop, in which the GC would review the performance of each alternative across a number of criteria (e.g., reduction in uncertainty, cost, other impacts), to identify which actions to prioritize for implementation. The outcome of this workshop will be a set of high priority field-research, modelling, and/or expert judgment activities aimed at improving understanding of the role of the Platte for pallid sturgeon.

We propose that this workshop could occupy an agenda item at a regular GC meeting.

Workplan

Figure 2 provides an estimated timeline for completion of the steps described above, beginning October of 2018. It assumes that outside experts are available on the timeline suggested. The timeline aims to have options ready for GC consideration at their March 2019 meeting. Estimated costs are summarized in Attachment 1.

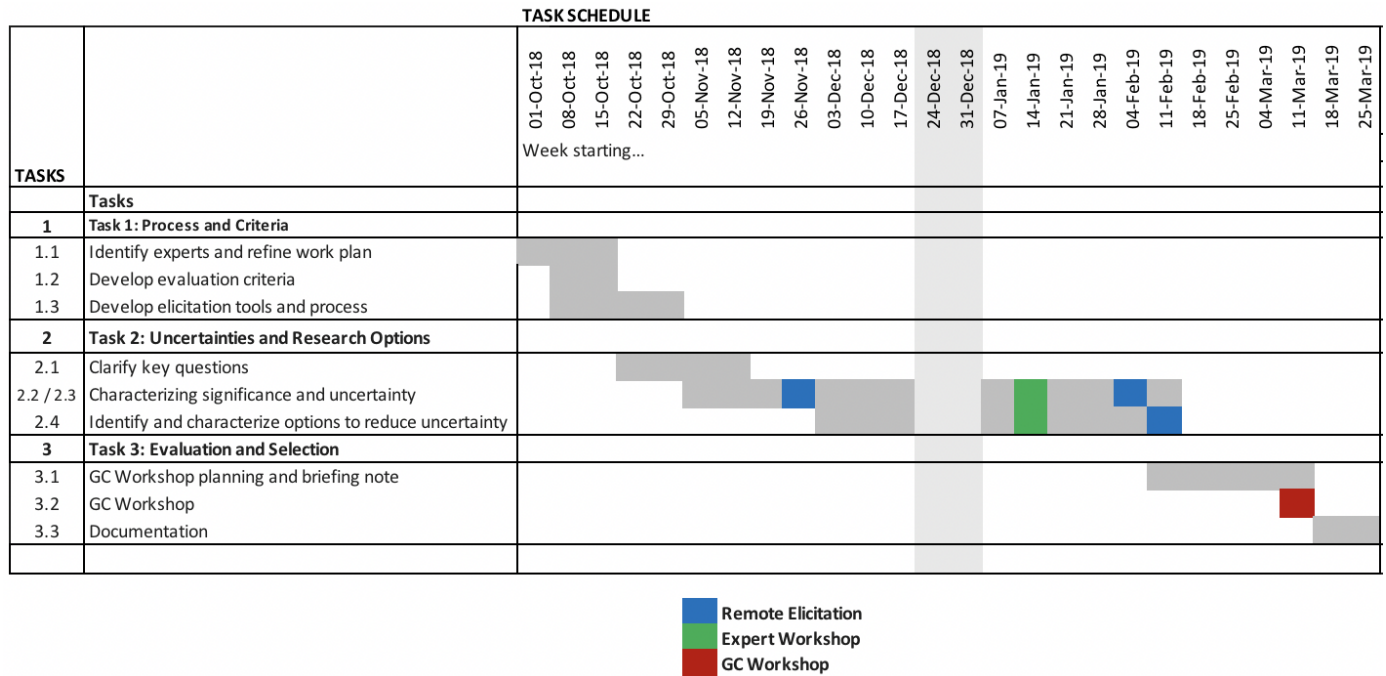


Figure 2. Illustrative timeline for the completion of tasks described above. Blue grey indicates major teleconferences or elicitations, green indicates expert workshops, and red indicates a final workshop with the GC.

Attachment 1

Budget: Proposed Pallid Sturgeon Decision Support

The total estimated budget is \$106,810, including all fees and expenses (Figure 1). All applicable taxes are extra. In developing this budget, we have made a number of assumptions and choices about the scope of and approach to the work. We are open to discussing alternative ways to meet the project objectives that better meet your needs and constraints if necessary.

The budget is subject to the following assumptions/conditions:

- All fees and expenses are in \$US;
- Expenses include estimated charges for all travel, accommodation and per diem fees for the Compass project team (meeting/travel expenses for other participants are the responsibility of others);
- Travel and accommodation expenses are billed at cost (no mark-up);
- A 5% Administration fee is applied to fees;
- All applicable taxes are extra;
- The EDO is responsible for scheduling meetings, inviting participants, distributing materials, and arranging all meeting-related logistics including venue bookings, meals and refreshments, multi-media equipment (projector, phones, internet);
- The EDO is responsible for ensuring timely input from their team and external technical experts;
- Fees for the participation of any external experts are not included;
- Any reports will be submitted electronically (no printing or desktop publishing is included).
- Assumed 2-3 day January workshop location: Denver CO.

With respect to the use of on-line tools, note that Compass has developed a suite of tools to facilitate the development of impact pathway diagrams and associated information databases, the elicitation of expert judgment, the evaluation of systems-level uncertainty and the development of monitoring programs to reduce uncertainty. These tools will be adapted and customized to meet the needs of this project. The Program will have access to any on-line tools for the duration of the project, and any outputs from these tools will be available to the Program at the end of the contract. If the Program would like continued access to the tools to update them after the close of the project, we can provide cost estimates for continued hosting and access.

PROPOSED BUDGET								
TASKS		L Failing	P Halteman	C Beaudrie	Support	Days per task	Fees per task	Fee and Expenses Subtotals
		\$ 1,600	\$ 1,200	\$ 1,200	\$ 800			
		Days	Days	Days	Days			
	Tasks							
1	Task 1: Process and Criteria							\$ 13,600
1.1	Identify experts and refine work plan	0.5	1.0	1.0	0.0	3	\$ 3,200	
1.2	Develop evaluation criteria	0.5	1.0	1.0	0.0	3	\$ 3,200	
1.3	Develop elicitation tools and process	0.5	1.0	1.0	5.0	8	\$ 7,200	
2	Task 2: Uncertainties and Research Options							\$ 56,400
2.1	Clarify key questions	1.5	4.0	5.0	2.0	12.5	\$ 14,800	
2.2 / 2.3	Characterizing significance and uncertainty	3.0	11.0	9.0	5.0	28	\$ 32,800	
2.4	Identify and characterize options to reduce uncertainty	1.5	2.0	2.0	2.0	7.5	\$ 8,800	
3	Task 3: Evaluation and Selection							\$ 28,460
3.1	GC Workshop planning and briefing note	2.0	4.0	4.0	2.0	12	\$ 14,400	
3.2	GC Workshop	0.0	3.0	3.0	0.0	6	\$ 7,200	
3.3	Documentation	0.5	0.5	2.0	0.0	3	\$ 3,800	
		10.0	27.5	28.0	16.0	82		\$ 102,040

Total Fees	\$ 95,400
5% Admin	\$ 4,770
Expenses	
Air Travel	\$ 2,600
Accommodations	\$ 2,660
Per Diems	\$ 980
Ground Transport	\$ 400
Total Expenses	\$ 6,640
Total	\$ 106,810

Figure 1. Estimated Budget