Independent Science Advisory Committee (ISAC)

Responses to Questions Posed by the Platte River Recovery Implementation Program (PRRIP) in October 2015

Submitted to
PRRIP Governance Committee

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The Platte River Recovery Implementation Program (PRRIP or Program) requested written input from the ISAC on five questions. These questions were the focus of discussions during the October 13-15, 2015 AMP Reporting Session in Denver, CO. To enable the Program to easily extract ISAC recommendations from our overall discussion of the questions posed to us, we have put our recommendations in **blue** text, numbered sequentially. These recommendations are contained within the context of the overall discussion of each question so that our rationale is clear.

General ISAC Comments on the 2015 AMP Reporting Session

In previous years the ISAC has made recommendations to ensure that the presentations at the AMP Reporting Session are clearly linked to Big Questions and/or priority hypotheses. In past years we have been very pleased with the progress made on this issue, at both AMP Reporting Sessions and in the State of the Platte reports. However, it appeared that there was some backsliding this year. Many of the presentations (some by contractors, some by EDO staff) did not answer the critical question: “So… why does this matter to the Program?”. This was frustrating to the ISAC, TAC and GC members attending the reporting session, and several times sparked questions to clarify the relevance of the activity that had just been presented. The ISAC therefore makes the following recommendations:

1. **All statements of work and products for both EDO staff and contractors to the Program should clearly identify how the work or product links to the AM Plan (e.g., implementation of actions, one or more BQs, one or more priority hypotheses), and emphasize the requirement to make explicit such linkages at any presentations given to the Program.**
2. **The start and end of each report/presentation at the AMP Reporting Session should make a clear link to relevant components of the AM Plan.**
3. **Ideally, the EDO should conduct webinars with all presenters prior to the AMP Reporting Session, to ensure that linkages to the Program have been made in the report and presentation, and provide draft final presentations to the ISAC one week before the reporting session.**

Session 1 – PRRIP Target Species (Interior Least Tern, Piping Plover, Whooping Crane, Pallid Sturgeon)

1) Are the assumptions, methods, results, and conclusions in the whooping crane habitat selection analysis report reasonable?

Reference Document: 4 – Whooping cranes Habitat Selection Report & Presentation

General Comments

The ISAC believes that the analysis by WEST Inc. was well done, and that the conclusions are reasonable. The use of a **systematic unique** approach (first arrival) is logical since the first habitat selection is the most important choice (i.e., selecting from a flying elevation > 1000’), whereas later habitat selection is from a much smaller area strongly conditioned by the first choice. Using all of the data did not markedly change the selected covariates (Howlin and Adachi, pg. 153), though different models were fit. The ISAC is not convinced that habitat in the Central Platte is limiting the whooping crane population; only a very small number of whooping cranes arrive in a relatively large area.

The following paragraphs provide some ISAC recommendations on the bolded topics.

Reliability of models.

4. While the ISAC recognizes that the methods do not allow for a simple explanation of the percent of variation explained by the models, **it would be worthwhile applying various approaches to evaluate the reliability of the predictions for all of the data sets (both Platte River and Great Plains), and to assess the ability of these models to predict both use and non-use (e.g., a 1-fold cross-validation approach).**

5. The mirrored histograms of use and availability for key covariates were helpful, and should be supplemented by more quantitative approaches, such as **a nonparametric, 2-sample Kolmogorov-Smirnov test to formally compare the use and availability distributions.**

Cutting off distributions at 75th percentiles

While the ISAC agreed that this was a reasonable approach, there are some supplementary approaches which would help reviewers of these manuscripts to gain confidence in the analyses:

6. **Point out the influences of outliers at the extreme right of the graphs of relative probability of use vs covariates**;
7. **Make biological arguments that whooping cranes are unlikely to avoid greater values of Unobstructed Channel Widths (UOCW)**, as in Figure 49 on page 84 of Howlin and Adachi (2015);

Covariates used and relative amounts of contrast

8. **Provide a table of summary statistics for each covariate and the response. This table should include the CVs of all covariates, to illustrate the relative amounts of contrast available in each covariate to explain the variability in habitat selection.** For example, flow is unlikely to vary over most 10 mile reaches on a given day, so habitat selection wouldn't be driven by flow in such reaches.
9. The preferred flow for whooping cranes is a management question of interest. Whooping cranes may have a preferred range of water depths (e.g., < 8-10") which is not captured by unit area discharge. The ISAC understands that mean depth was considered as a covariate, and that the Program is not able to manage the proportion of the channel cross-section with a given depth range, which might be maximized at a given flow. **Perhaps it would be helpful to examine the explanatory power of an interaction term, such as flow * wetted width.**
10. It is possible that the presence of very large numbers of Sandhill cranes affect the selection of landing areas by whooping cranes (either negatively if Sandhill cranes are perceived as a potential competitor, or positively if landing in a crowd lowers the risk of predation). **It might be worth exploring this possibility as part of the whooping crane habitat selection analysis if sufficient data are available on Sandhill cranes, and if there is enough spatial contrast in their distribution**.
11. The authors need to explain the sensitivity analysis that was done to show that 20 random points was sufficient to accurately estimate covariates for available habitat.

Conclusions on Habitat Selection

12. **The conclusions need to stress that whooping cranes use a wide range of Unobstructed Channel Widths (UOCW) and other covariates like NF (distance to nearest riparian forest).** The data do not show a very strong selection for UOCW, and whooping cranes may be using other habitat or population features to select where they roost. The probability of use is maximized at a certain value (e.g., 500 to 800'), but this value is not necessarily "optimal".
13. **From a management standpoint, it is important to reiterate other empirical evidence which is relevant to the preferred values of UOCW and NF. It's reasonable for the Program to manage habitat covariates for the highest probability of use, while at the same time recognizing that whooping cranes may land in the Platte River at locations with lower or higher values of these covariates.**

Land Cover Selection

14. It would be **worth looking at allocation of time across habitats that are used for feeding during the spring time (wet meadows, corn fields, other fields like soybeans, grasslands), and remove areas less likely to be used for feeding (channel, developed land, trees).**

Trend Detection

The high variability in year to year abundance of whooping cranes suggests that there are many factors besides conditions in the Central Platte that affect trends over time.

15. It is good to report the level of support for positive or negative trends, and describe the p-values, but **please do not use terms like "marginally significant"**.
16. **It's important to look at the average length of stay of whooping cranes and see if there are any trends in that variable, which might indicate positive or negative changes in habitat stopover quality.** It may or may not be possible to compare the length of stay in the Platte area with comparable areas and times from larger telemetry data set
17. Should the lines on page 15-6 be fit to the data only from 2007 on (program existence onwards)? If so, the slope would be a lot higher.

2) Are the assumptions, methods, results, and conclusions in the Whooping Crane Habitat Selection Synthesis chapters reasonable?

Reference Document: 5 – whooping cranes Habitat Selection Synthesis Chapters & Presentation

General Comments

18. **The authors should evaluate the potential for combining chapters 2 and 3 into one manuscript, and to clarify differences among the two data sets.** The following comments provide some detailed recommendations:
    a. If the decision is made to keep the two chapters separate, then the authors need to improve the consistency among the two chapters, reference each other, and ensure that both introductions and discussions refer to both data sets.
    b. The authors need to explain all the covariates at the beginning of the manuscripts (i.e., either at the beginning of one combined paper, or at the beginnings of two separate papers) and the reasons for somewhat different covariates for NF in chapters 2 and 3.
    c. It would be worth having some figures to illustrate the different methods of deriving NF (somewhat like the figures in Appendix D of the 2014 State of the Platte report).
    d. If would be worth applying the Great Plains method of deriving NF to the Platte data using the same methods, as a separate sensitivity analysis.
19. **The authors should explain the potential reasons for differing results with different data sets** (e.g., a UOCW of 500' has the maximum probability of use from Platte in chapter 2, but the maximum probability of use is 700' using data from other rivers (excluding the Missouri River) in chapter 3).
20. **Conclusions need to be carefully phrased to reflect what the data show, e.g.:**
    a. '50% of the whooping cranes used an UOCW > 508', and one third used an UOCW > x'.
    b. 'a UOCW management target of "at least 600 ft." maximizes probability of use'
    c. 'a minimum habitat criterion for UOCW of 200' is consistent with the results of the analysis'
21. **The authors should anticipate future uses of the analyses and provide multiple metrics of management relevance** (e.g., show total channel width to compare with UOCW, since the USFWS uses total channel width).
22. **The Program should maximize the use of all available data sets (e.g. Program data, USFWS data, USGS data), and to describe what these data sets are, including their compatibility, strengths and limitations**. For example:

a. Most USFWS data on whooping cranes is already included in the data set that was analyzed, except for data prior to 2001 which may not be usable because of limitations in the data on habitat availability;

b. Assess the effect of other USFWS data on the conclusions drawn (e.g., observations outside of the sampling window within a given year, coarser data covering a longer time period), which may or may not require doing further quantitative analyses.

Chapter 4 - Physical Characteristics of the Central Platte River: Whooping Crane Habitat Creation and Maintenance through Disking, Herbicide, and High Flow Events

The ISAC has the following recommendations for this chapter:

23. **Use similar methods as described above under recommendations 5 and 6 to test the reliability of models (e.g., % classification).**
24. **Show graphs of the predictive equations vs. flow with multiple lines showing the probability of getting a channel of various widths.**
25. In Figure 5 (page 22 of Chapter 4), the 95% confidence interval at 8000 cfs peak discharge does not encompass the management criterion of 600' UOCW. **This important finding needs to be clearly stated in the report.**
26. **Explain the mechanisms of why lower flows are insufficient (magnitude, duration, both). For example,**
    a. durations above 8000 cfs explain a lot of variation in ΔUOCW,
    b. the duration of inundation of channel widths above 600'
    c. potential lag effects from previous years' flows (e.g., Qt, Qt-1)
    d. describe flow characteristics that are associated with different channel widths (e.g., current river flows over the last 8 years without SDHF can maintain 400' channel widths, but a majority of whooping cranes use UOCW's > 400', and there is an unquantifiable risk to the population of a narrower channel, including greater vulnerability to predation
27. **Openly discuss the burden of proof issue, which ultimately reflects policy decisions on acceptable risk:**
    a. a precautionary approach is to maintain channel widths wider than 600' based on maximizing probability of use; but
    b. It's difficult to show at what channel width there is a decline in survival or fitness.
28. **Discuss what's required for channel maintenance during wet and dry periods, and create state-dependent rules for different periods.**
29. **Discuss the carrying capacity issue.** There are a number of possible explanations for the current situation. Low numbers of whooping cranes could imply that there's a lot of habitat (nowhere near carrying capacity), or that the habitat is inappropriate, or that there simply aren't many whooping cranes in the population. It's also possible that Sandhill cranes affect the available carrying capacity in spring, as discussed above under recommendation 11.
30. **Discuss where to focus disking efforts during dry periods.** These decisions will be constrained due to property ownership, but ideally it would appear to make sense to focus on areas where whooping cranes have historically appeared, assuming that there is some fidelity to those locations. Is there?

Session 2 – Structured Decision Making (SDM) Background

3) Does the ISAC have any further recommendations regarding the scope of or process for Structured Decision Making (SDM) as a tool to help the Program get through the "adjust" step of the adaptive management cycle for Big Question #1?
Reference Document: 6 – SDM Presentation

The ISAC supports both the intended process for Structured Decision Making, and the expert selected to lead that process with the GC (Ms. Lee Failing of Compass Resource Management). We have the following recommendations:

31. While the ISAC agrees that it's worth applying this structured process to BQ1 without making the decision problem too complicated, **the Program needs to think about the implications of answers to BQ1 for answers to other BQs, since BQs are interrelated.** Some of the issues worth considering include the following questions and comments from the ISAC:

a. Will SDM on BQ1 help with decisions on other BQs (e.g., BQ 2, 4, 6, 7)?

b. What are the relationships between decisions on BQ1 and other BQs?

c. If you want birds nesting on in-river islands, then this will require water to ensure that in-river bars remain moated

d. **It's important to carefully frame the decision question on the Platte.** Since there are no targets for amounts of habitat or numbers of birds in PRRIP, the decision questions appear to be resource allocation issues: what is the best use of X amounts of money and Y amount of water, and Z amount of land? Is it better to focus land / water on least terns, piping plovers or whooping cranes? On off-channel habitat or in-channel habitat? Optimization questions still have constraints, given the multiple habitats and species that need to be created and maintained (e.g., how to ensure that all species' habitat needs are satisfied).

Session 3 – Structured Decision Making (SDM) Technical Tools

4) Does the ISAC have any recommendations to improve the tern/plover conceptual ecological model (CEM) or the related Excel spreadsheet tool developed for use in the SDM process?
Reference Documents – 7 – Tern/Plover CEM & Presentation and 8 – Excel model

Conceptual Ecological Models

The ISAC liked the simplicity and elegance of the CEM for the birds' life cycle, and the changes in habitat availability over time. Both rings are very intuitive, and are similar to other approaches adopted for birds migrating past the oil sands in Canada (e.g., Nelitz et al. 2015), as well as for salmon populations (e.g., Bottom et al. 2005). A challenge is how to maintain the simplicity of the overall life cycle, while at the same time creating enough room for Platte-focused components, without generating too much complexity. The ISAC has the following minor recommendations:

32. For the Incubation / brood rearing life stage of the piping plover CEM: add predation; differentiate between factors that affect all populations (e.g. predation, weather, disturbance, abandonment) vs. those that only effect on-channel nesting (e.g., very high flows, very low flows); and possibly use two rings (one for off-channel, one for in-channel).

33. Add vegetation establishment as a negative for on-channel habitat in the Habitat CEM

34. **Consider varying in width the general life history outer circle to emphasize those activities that occur along the Central Platte vs. those that occur elsewhere and are outside of the Program's influence.**

Spreadsheet Model

The model appears to be very clear and easy to use, though ISAC members did not have time to test it out. We recommend the following steps to increase the use and understanding of the model:

35. **Develop an easy users' guide for people who are less comfortable with models, including some example scenarios.**
36. To maximize the opportunity for dialogue with the Governance Committee, **it will be important to be able to export spreadsheet model output into the matrices showing the consequences of all alternatives, and to be able to easily compare alternative sets of management actions.**
37. **Have a workshop with the Technical Advisory Committee, jointly exploring the effects of different example scenarios with the model;** and
38. Later on in the SDM process once alternatives have been defined, **complete a sensitivity analysis of management alternatives,** to determine which parameters affect the relative ranking of the alternatives. This will be a much smaller set of parameters than those which have the greatest effect on bird abundance, as found in other decision analyses (Peters and Marmorek 2001). Such sensitivity analyses can help to prioritize research, monitoring and AM activities.

<u>Sessions 4 and 5 – PRRIP Water Topics</u>

5) **Does the ISAC have any relevant thoughts and feedback to provide the Program regarding the presentations and topics addressed during these sessions?**
Reference Documents: 9 – Water Timeline Presentation, 10 – Wet Meadows Hydrologic Monitoring Presentation, 11 – Water Action Plan Presentation, 12 – Flow Summary, & 13 – High Flow Analysis Report

9 – Water Timeline Presentation

The ISAC believes that assembling the water timeline has been a very useful effort for helping to understand changes in system hydrology. This database will be a key input to the ongoing analysis of how well the river used to work historically, and changes that have occurred since that time.

39. **We recommend focusing effort on collecting data for the larger water diversions,** which will yield the greatest benefit per unit effort.

10 – Wet Meadows Hydrologic Monitoring Presentation

The ISAC was impressed with the quality of this research, but at the time of the presentation we were confused about its purpose. We later learned that the primary purposes of this work are to determine what river flows (or irrigation flows) are required to maintain wet meadows (so as to inform water management activities), and to characterize the functions of wet meadows.

40. **The purposes of this work need to be more clearly defined (e.g., linkages to BQ 5, BQ 10 and hypothesis PP-4)**
41. Some peer reviews had recommended doing measurements of evapotranspiration rather than estimates. **Given the above-described purposes for this applied research, the current methods used to estimate evapotranspiration are sufficient.**

42. The Program should further investigate the importance of wet meadows to whooping cranes. There is some inconsistency in the findings regarding use of wet meadows by whooping cranes. The summary of analyses of habitat use presented by WEST at the AMP Reporting Session indicated that whooping cranes are rarely found on Program defined wet meadows, and select against using them (i.e., 10% availability, 2% use in Figure 1 (inserted below from the AMP presentation, but not found in Howlin and Adachi 2015). However, other models of in-channel habitat selection in Howlin and Adachi 2015 suggested that whooping cranes do select *in-channel* habitats near wet meadows (e.g., page 86 and 116). The overall pattern of lack of use of wet meadows by whooping cranes (Figure 1) could reflect a lack of synchrony of meadow wetness and whooping cranes arrival[1]. Questions worth exploring include:

a. Are whooping cranes in the region when meadows are wet (i.e., do wet meadows overlap in time with whooping cranes presence)?

b. Are whooping cranes choosing different areas to roost (e.g., cornfields) at a time when meadows are wet (overlap in space)?

c. Do the small sample sizes permit reliable conclusions on wet meadow use?

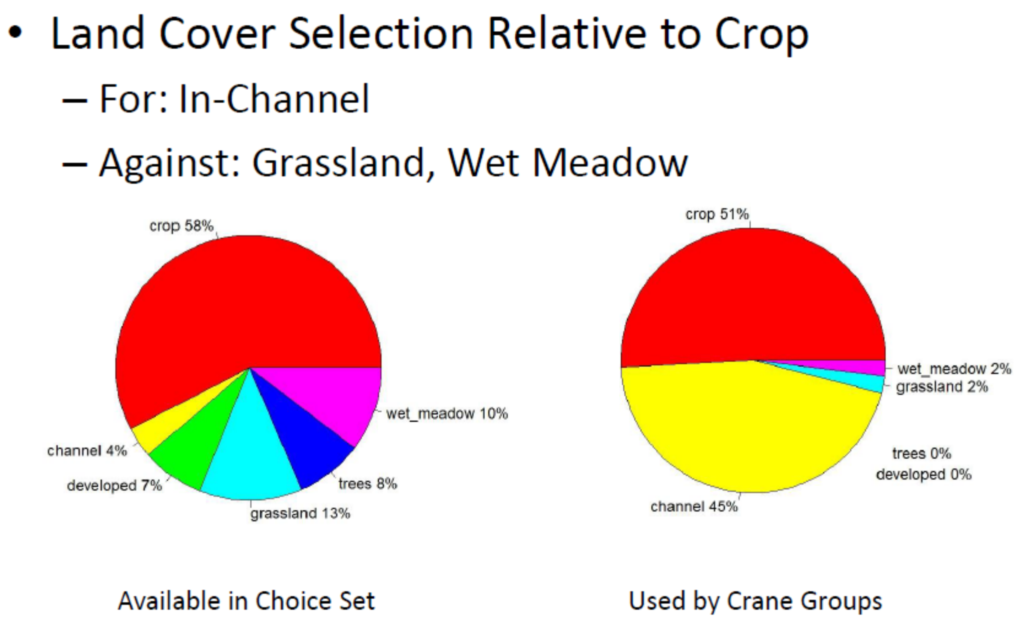

Figure 1. Spring and fall use of various habitats by whooping cranes compared to the availability of those habitats, for the Top Diurnal Model. Source: Slide 33 in presentation by Shay Howlin on October 13, 2015.

43. The Program needs to ensure that different investigations of habitat use each apply consistent definitions of wetlands (i.e., wet meadows, marshes, prairie ponds, etc.). Wet meadows are only a subset of wetlands. The Program needs to understand whooping crane use of all forms of wetlands.

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[1] The ISAC learned from the EDO that wet meadows were not wet during whooping cranes use during the last 3-4 years when whooping cranes arrived in spring. Meadows were very wet in 2015 but were not used. It would be helpful to extend the time series of such observations.

44. Figures 1-4 (2015 Wet Meadow Hydrologic Data Summary Draft) illustrate site-specific time series of ground and surface water elevations. **Please add the ground surface elevation (ft.) so that it's clear when the ground surface was wet and to what depth (i.e. relevant to WC use). Additionally, it would be informative to add horizontal bars that show when WC were observed along the Central Platte (not necessarily at a specific site) to illustrate if there is synchrony of meadow wetness and timing of crane use. This clarification illustrates the need to more effectively link Program products to Big Questions and/or priority hypotheses (See General ISAC Comments on the 2015 AMP Reporting Session).**

11/12 – Water Plan Update & Flow Summary

These updates were useful but could be shortened, focusing on recent changes and the implications for management decisions.

45. Previous investigations by the EDO and ISAC have noted that the assumptions used to derive target flows in the 1990's are questionable in light of more recent information. The ISAC understands that in spite of these questionable assumptions, target flows have been a convenient metric for measuring progress towards providing water for the Platte River. Nevertheless, **it would be worth exploring whether the application of target flows has the effect of increasing July flows during the period when birds are nesting.** Flow management should logically avoid flooding in-river nests.

Session 6 – Geomorphology

6) Does the ISAC have any relevant thoughts and feedback to provide the Program regarding the presentations and topics addressed during these sessions?

Reference Documents: 14 – Geomorphology/Vegetation Monitoring Report & Presentation, 15 – Shoemaker Island FSM Presentation, 16 – Channel Model Presentation, & 17 – Sediment Augmentation Presentation

14 – Geomorphology/Vegetation Monitoring Report & Presentation

15 – Shoemaker Island FSM Presentation

The rotating panel design in the original AMP (2007, pdf pg. 214-216 & pg. 223-224) were meant for getting moving averages of channel characteristics like mean depth, mean channel width, mean and gradient size, as well as for estimating changes in sediment aggradation and degradation. The high variability in the results of analyses of sediment aggradation and degradation (presented by Bob Mussetter of Tetra Tech) suggest that the spatial and temporal variability in these processes is much greater than was initially anticipated back in 2007 when the system-wide design was developed. Furthermore, changes in technology have changed value of the original design (e.g., Green LIDAR can potentially provide a census of channel attributes, reducing the need for detailed studies of cross-sections). Data on spatial and temporal variability are very valuable for revising and improving sampling designs. It isn't clear what the best approach is to reduce the large degree of uncertainty in estimating changes over time in sediment aggradation and degradation (i.e., great spatial resolution of transects, versus greater temporal resolution of sediment transport measurements). The logical next steps are to do further reconnaissance of multiple pathways, namely:

46. **Review the original system-wide monitoring design to assess the validity of the assumptions that were made.** The original design recommended 10 transects at each anchor point, while the current monitoring plan has only 3 transects at each anchor point (the Program decided to do more anchor points and fewer transects at each anchor point). **Explore using the Shoemaker Island intensive monitoring data to evaluate the validity of the original design, and subsequent changes to that design.**

47. **Add one more year of observations, completing 2 cycles of the original rotating panel design.** This will allow time to check on whether or not Green LIDAR works, and provide an overlap of both methods to provide a comparison of these methods.

48. **If Green LIDAR does not work (i.e., provide sufficiently accurate cross-sections), the Program should focus on a smaller more intensive area of transect measurements.**

49. **It's not clear that collecting more sediment transport data from bridges is worthwhile, since bridge piers and narrow channels perturb sediment transport. An alternative is to collect sediment transport data (using handheld samplers at wadeable flows) *away* from bridges.** It should not be very expensive to try this out, and compare the resulting sediment transport functions. These data could also be used to calibrate an appropriate bed material load relationship like Engelund-Hansen, which could be compared to relationships derived from the existing sediment transport data. Analyses performed by Tetra Tech indicate that flows in the range ~800-3300 cfs are responsible for most of the variance in sediment transport estimates. Some of the sediment rating curves presented at the meeting appear to have very few observations below 2000 cfs; thus, collecting additional sediment transport observations in the 1000-2000 cfs range could potentially reduce uncertainty in the sediment balance analysis across the full range of flows. [2] **If Green LIDAR provides the detailed information on bed topography for estimates of sediment aggradation and degradation, then there may be an opportunity to rethink the sediment sampling approach.**

50. **Use the finer resolution Shoemaker Island data as "truth" to explore the effects of various coarser sampling approaches.** The ISAC recognizes that the Shoemaker Island was deliberately selected as a test site for FSM, and therefore isn't representative of the overall Central Platte River. We nevertheless feel that these data are valuable for assessing the required density of transects for evaluating sediment

[2] Subsequent to the meeting, Bob Mussetter provided the following response to an ISAC question about whether sediment transport measurements would be valuable at lower flows:

> "Based on Brian's question on Monday, I did a preliminary evaluation of the effects of the different ranges of discharge on the amount of variability in the aggradation/degradation estimates over the period of the monitoring surveys (2009-2014) in the Overton to Kearney Reach. I calculated the total sand load passing each station in discharge increments of 500 cfs (lowest range was 0-100 cfs, and second lowest was 250-500, rest were 500 cfs each) for each of the 1,000 trials in the Monte Carlo analysis. I then took the difference for each trial in each discharge increment (i.e., calculated the net change in the reach associated with each discharge increment), identified the 5% (low end) and 95% (high end) exceedance values for each discharge increment from the 1,000 trials, and then calculated the percent of the total associated with each increment. The results indicate that, in spite of the very wide tails on the confidence bands, the vast majority of the variability is still associated with flows in the range of the existing sediment transport measurements (roughly 1,000 cfs to 12,000 cfs). From this, I conclude that spending a lot of resources collecting more data in the low-flow range to tighten up the bands wouldn't do a whole lot to narrow the confidence bands."

Brian Bledsoe of the ISAC responded as follows:

> "Bob, thanks for this -- makes sense. It looks like flows between ~800-3300 cfs are responsible for most of the variance. Some of the selected plots you showed at the meeting had very few observations below ~3000 cfs; however, I don't know whether this is the exception or the norm. The basic idea was that more observations in the low end might tighten up the confidence bands on the mean response *throughout* the regression. One could compare the number of observations in a given flow range to % variance produced by that flow range and play some games with adding hypothetical observations to the bins with the fewest observations per variance to see how much it tightens up the confidence band across the full range. Another option we discussed after you left would be to calibrate the low end of a relationship like Engelund-Hansen with some waded measurements (away from bridges) and use it for the same sort of analysis. Of course that would raise questions on how to estimate the shear stresses that drive an 'off the shelf' bed material load relationship like Engelund-Hansen. Please let me know if you want to discuss."

aggradation and degradation, at least in similar channel sections. We first make two observations and then three recommendations:

a. The Shoemaker Island study originally had 18 transects (one every 800'), and then doubled it in 2015 to 36 transects (one every 400'), and according to the investigators (Smokey Pittman of GMA) found the more detailed data to be more reliable.
b. The Shoemaker Island transect density is 11 to 22 times more intensive than system wide transect density (3 transects every 5 miles, or 3 transects every 26,400'). System wide sampling would have only 2.7 sets of 3 transects (8 total transects) over the whole Shoemaker reach.
c. Use Shoemaker Island data on spatial variability to do a statistical power analysis on the ability to detect changes in aggradation with the system-wide sampling method. It would also be worthwhile exploring the variability across the three transects that are monitored at each anchor point as part of the system-wide protocol.
d. Sub-sample Shoemaker Island data repeatedly and see how the conclusion on sediment aggradation / degradation changes as you move from one integrated sample of 66 transects to 22 random samples of 3 transects (i.e., equivalent to the system wide sampling resolution). It would also be worth exploring the effects of using a 3-transect moving average.
e. Relate the findings of these investigations back to practical questions, like the benefits of SDHF, the design of in-river sandbars, and developing tools that can be used to predict the effects of sediment augmentation.

16 – Channel Model Presentation

This work could be helpful for assessing hypotheses that increases in *current* discharges should remove vegetation, like they *apparently* did historically. Addressing that hypothesis using historical information on channel geometry and vegetation, together with current information on what shear stresses are required to remove plants, would allow a retrospective examination of this hypothesis. However, this hypothesis test will only be as credible as the historical data used as inputs to the historical HEC-RAS model. The ISAC recommends:

51. **The Program should provide stronger rationale for historical channel geometry, including channel stratigraphy, incorporating a realistic amount of topographic variability from 1938 imagery, or exploring that channel attribute in a sensitivity analysis**
52. **Once the model is 'reasonably credible', use it to explore the possibility that tern nests did not get flooded in the past**

17 – Sediment Augmentation Presentation

Sediment augmentation is important because serious degradation will narrow and deepen the channel, which is not desired for any of the species, and because there is crane, tern and plover use in this area, both in-channel use and off-channel use. Other than at the J2 return, there isn't compelling evidence of the need for sediment augmentation; the existing evidence is contradictory. The ISAC was asked the questions listed in Table 1.

Table 1. Questions related to the implementation of sediment augmentation that were posed to the ISAC at the AMP Reporting Session, and **ISAC responses**.

Questions Posed to the ISAC	ISAC Responses and Recommendations
1. The objective of sediment augmentation is offsetting the J-2 deficit. How do we translate that objective into augmentation volumes? *Is 60,000 T effective?*	The two lines of evidence that were used (HEC6T, comparison of LIDAR surfaces) seem defensible as do the conclusions of 60,000 T. It is important to describe the results of the modelling.
2. What augmentation efficiency should we assume? *60% of the material is finer than 1.0 mm, ~8% gravel. Assume 80-90%?*	You need to approach this question empirically, quantifying the amount of sediment augmentation in the J2 channel, and the amount of change in LIDAR-estimated cross-sections downstream while J2 is dry, to estimate whether your assumptions were correct. It is better to have too much sediment transport than too little. Push the sediment in during higher flows in J2 in spring prior to nesting season, and during fall when whooping cranes are absent.

3. How will the channel respond to augmentation? *Dominant change: widening vs. adjustments in channel slope?*	Look at the proportionalities between width, slope and sediment transport capacity, to ensure that sediment gets moving down the river:
	- You could have bars which increase roughness and slow down transport capacity
	- It would be good to make *a priori* measurements and predictions about how both habitat and birds will respond to sediment augmentation, such as:
	    o leveling out the trend of decreasing depth in the south channel, reducing the degradational trend at Overton stream gage, adding other transects upstream of Overton bridge
	    o increased formation of in-river bars,
	    o increased nesting on these bars by terns and plovers,
	    o increased channel width, increased use by whooping cranes

4. Work downstream to upstream or vice versa? *REACH – upstream to downstream; SITE – downstream to upstream?*	It's logical to start upstream and then move downstream. This provides the greatest ability to correct actions over time (i.e., you won't create a plug at the downstream end).
5. Where do we measure performance and how to do we define success? *No trend in degradation at Overton gage? No slope change from confluence to Cottonwood Ranch?*	See responses to question 3 in this table.

References Cited

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