ISAC Report: Responses to ISAC Discussion Questions for the July 2024 ISAC Meeting

Independent Science Advisory Committee (ISAC)

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Photo credit: Platte River - Dyer Property sediment augmentation site; July 17, 2024; David Marmorek

Prepared by the ISAC

Mr. David Marmorek, ESSA Technologies Ltd. (Co-Chair)
Dr. Jennifer Hoeting, Colorado State University Emeritus (Co-Chair)
Dr. David Galat, University of Missouri (Retired)
Dr. Alan Kasprak, North Rim Research, LLC
Dr. Aaron Pearse, U.S. Geological Survey
Dr. Michal Tal

A Tribute to Dr. David Galat, ISAC Member 2009 - 2024

David Galat, July 2024, Photo by Michal Tal

The ISAC would like to thank our colleague, David Galat, for his many contributions to the ISAC and the PRRIP. David was one of the original ISAC members at its founding in 2009. Since that time, David has been a tireless and enthusiastic ISAC member. David provides many new ideas and keeps the ISAC focused on the PRRIP priorities. This will be David's last ISAC report. Thank you David for your dedicated and inspired contributions to the ISAC over the last fifteen years - we will miss you!

Table of Contents

Executive Summary of ISAC Recommendations

<u>ISAC Question 1</u>: Extension Big Question (EBQ) Reframe

What is the ISAC's Assessment of the following question for each EBQ presented in the Reframe Document: Do we know enough already to estimate relationships (with confidence) and stop focusing on this EBQ?

ISAC response to ISAC Question 1:

- The ISAC recommends further study for all EBQs except EBQs 6 (fall vs spring WC use) and 10 (wet meadows). Further study will substantially improve the quality of information available for PRRIP management decisions
- We recommend that the Program carefully consider success metrics for each EBQ.
- Major recommendations for some EBQs are listed below. For additional details and other useful ISAC recommendations, see report below.

EBQ 1: Water to maintain suitable* whooping crane roosting habitat

ISAC recommendations:

- Examine multi-year patterns of discharge, and their eco-geomorphic implications.
- Calibrate hydraulic models and improve morphodynamic models at the reach scale using existing data. This will create robust predictive tools for decision makers.
- Generate outputs for the machine-learning model for different reaches along the AHR in addition to the output averaged over the entire AHR - if possible using the current model.

EBQ 4 and 5: WC stopovers

The ISAC recommends that the Program develop a contingency plan for when the telemetry study ends in case there isn't a definitive answer to EBQ #4 and #5.

EBQ 7: Pallid Sturgeon

The ISAC recommends that hydraulic models should include temperature, as Pallid Sturgeon movement and spawning are correlated with temperature.

EBQ 8 and 9: Piping Plover productivity and predation losses

ISAC recommendations:

- Conduct 1-2 more seasons of data collection to investigate EBQ #8 and #9.
- Examine costs and benefits to determine the most cost-effective type of predator control at OCSWs.
- Compare the rates of predation in the Platte River (off-channel sand and water sites) with rates on the Missouri River (in-river emergent sandbar habitats).

EBQ10: Wet meadows research

ISAC recommendations:

- Edit the wet meadows report based on the peer review and produce a final Program report ASAP.

- Consider examining the costs and potential benefits of enhancing wet meadow areas which have groundwater depths close to those required for self-sustaining wet meadows, using the models developed as part of the Program's wet meadows research.

ISAC Question 2: Sediment Augmentation No-Augmentation Plan and Monitoring

The No Augmentation monitoring plan is well designed. The 5-year experiment may provide useful contrasts with the preceding augmentation period to inform decisions about sediment augmentation.

ISAC recommendations:

- What is the "off switch" for the no-augmentation experiment? The Program should identify clear benchmarks for making annual decisions regarding continuation, cessation, or alteration of the experiment. Establish quantitative and spatial metrics for the benchmarks.
- What is the goal? The Program should clarify the desired objectives and outcome for the J2-Overton reach.
- Consider flow: Aspects of flow (magnitude, duration, rate of change) are just as important in river change as sediment supply; can changes in J2 flows be used in tandem with sediment augmentation to slow/stop degradation?
- Modeling and evaluation:
    - Account for confounding environmental and geomorphic factors in your analyses including (1) potential differences in flow between the augmentation and no-augmentation periods, and (2) potential time lag between the cessation of sediment augmentation and the emergence of observable geomorphic change.
    - Compare geomorphic change during the no-augmentation experiment with the rate and pattern of pre-augmentation change - even a qualitative analysis would be helpful.
    - Compare sediment transport rates and bed dynamics along the channel downstream of the J2 return to those along a control reach (e.g., the N. Channel or downstream of Overton); this would be useful for assessing how and by how much J2 channel dynamics differ from those of a steady-state channel.
    - Use available sediment models and data (with a range of assumptions for various uncertainties) to simulate the No Augmentation experiment for two purposes: 1) to determine appropriate thresholds; and 2) to assess the ability to detect exceedance of those thresholds (essentially a statistical power analysis).

<u>ISAC Question 3</u>: Whooping Crane (WC) Roost Site Selection Technical Report

ISAC recommendations:

- Biological issues: Consider multiple lines of evidence when considering how to identify resource allocation tradeoffs in a SDM framework. Each modeling approach and data set has strengths and weaknesses.
- Policy issues: Demonstrate and report the impact of the PRRIP on channel widths managed for WC use on Program-managed land.
- Statistical issues: When appropriate, use advanced statistical tools like bootstrapping to make inferences using the Resource Selection model.

ISAC Report: Responses to ISAC Discussion Questions for the July 2024 ISAC Meeting

Overview

The Platte River Recovery Implementation Program (PRRIP) requested a report from the Independent Science Advisory Committee (ISAC), addressing questions pertaining to the July 2024 meeting held in Kearney, Nebraska.

ISAC Questions and Program Extension Big Questions are in a blue box. ISAC responses are below each blue box and ISAC recommendations are in ***bold italics***.

PRRIP Summer 2024 ISAC Meeting ISAC Discussion Questions:

ISAC Question 1: Extension Big Question (EBQ) Reframe

What is the ISAC's Assessment of the following question for each EBQ presented in the Reframe Document:

Do we know enough already to estimate relationships (with confidence) and stop focusing on this EBQ?

The ISAC found the reframe document to be informative, focused and brief. ***The ISAC recommends further study for all EBQs except EBQs 6 (fall vs spring WC use) and 10 (wet meadows). Further study will substantially improve the quality of information available for PRRIP management decisions.*** For some EBQs this means that additional data collection is required. For others, additional analyses using existing data might be sufficient. ISAC recommendations are provided for each Extension Big Question below.

In our April 18, 2024 report (Responses to ISAC Discussion Questions for the February 2024 Science Plan Reporting Session) we recommended that the Program rephrase EBQ 1, 2, 4-7 so they're answerable with thumbs up/down. GC members have stated that the Program should stick with the EBQs as written and the EDO's Reframe document is an attempt to move forward. That's fine. However, the ISAC wants to emphasize that it is still important for the Program to clearly define what success looks like in order to determine whether "enough is known to establish relationships" to answer the EBQs. ***We recommend that the Program carefully consider success metrics for each EBQ.*** For example, a success metric for WC habitat could be defined as the number/proportion of channel segments ≥ 650 feet. Then this metric can be monitored over time. Each EBQ needs clear success metrics so that the program can be evaluated. We give additional guidance on this issue for several of the EBQs below.

Extension Big Question #1: How effective is it to use Program water to maintain suitable* whooping crane roosting habitat?

*Channels with ≥ 650 ft maximum width unobstructed by dense vegetation (MUCW) are highly suitable for whooping crane roosting.

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 1?

ISAC recommendations for EBQ 1 and 2

In addressing EBQ 1 and 2, it's important to recognize that there are multiple vegetation types (e.g., woody: willows and cottonwoods, grass: *Phragmites*, and annual herbaceous) and multiple management tools (inundation flows, herbicide spraying, mechanical removal). Suitable whooping crane roosting habitat is maintained by channels unobstructed by any dense vegetation, however different vegetation types have different mechanisms for expanding into the channel (seed germination versus stolons), responses to flow (scour, access to groundwater), and timeframes over which they need to be managed (one month versus multiple months).

The Program's management hypotheses for EBQ1 and 2 are that Program actions (water, spraying, mechanical) will increase the percent of AHR channel that remains highly suitable for whooping crane roosting. This leads to important questions that the Program should consider: How will the increase be assessed? For example, will the Program measure the change in the percent of sub-reaches with MUCW ≥ 650 ft as a function of the mix of three actions applied to each sub-reach? What Program actions are needed to maintain the existing suitable habitat? What are the relative costs and benefits of inundation and fall scouring flows vs mechanical vs chemical? What combinations of actions are most effective in dry and very dry years, when there may not be enough water for an inundation flow?

The Program should consider determining the optimal approach to using inundation flows, spraying herbicide and mechanical management for each area managed by the Program in the AHR. An optimal management strategy should be determined for average hydrological years as well as for extreme scenarios. If the Program is unable to spray for *Phragmites*, then higher flows or additional disking will be needed to maintain unobstructed channel widths. Likewise, if water is not available, increased spraying and / or disking will be needed to maintain unobstructed channel widths.

ISAC recommendations for EBQ 1

The ISAC recommends that the Program conduct additional research to address EBQ 1.
Knowing the answer to EBQ 1 is important for making water management decisions. Maintaining Maximum Unobstructed Channel Widths (MUCW) is important for whooping cranes. Given the low levels of confidence for estimating vegetation expansion in dry years, it will be useful to the Program to spend the time and resources to continue to understand these relationships so as to make the most effective use of limited water and money for channel maintenance.

Intra-annual variability in flow often confounds the development of relationships between hydrology and geomorphic response. While the Program has done a good job focusing on single-year patterns of discharge, ***the ISAC recommends that the Program also examine multi-year patterns of discharge, and their eco-geomorphic implications.*** More details are given below.

Additional ISAC comments for EBQ 1

- A huge amount of spatial data, over a large spatial extent, has been collected and continues to be collected annually. ***We recommend new/revised analyses to establish a better understanding of spatial variability in suitable habitat across the entire 90-mile AHR (e.g., proportion of each reach with MUCW > 650') and how it results from multi-year interactions amongst morphology, flow, and vegetation*** including:
    - What fraction of the AHR constitutes suitable habitat and how is it spatially distributed?
    - Consider classification of the AHR into generally homogenous geomorphic sub-reaches for management.
    - What is required (resources, costs) to maintain currently suitable sub-reaches and what is required to convert non-suitable sub-reaches to suitable? Are there sub-reaches where it's not worth the effort versus sub-reaches where a small nudge would go a long way?
    - The Program could create a thumbs-up/thumbs-down map to answer EBQ1/ EBQ2 on a sub-reach by sub-reach basis.
    - Analyze dimensionless bed relief index (BRI*; Liebault et al., 2012) to assess planform trajectories.
    - Analyze spatial variations in at a station hydraulic geometry, or how flow is distributed along the width of the channel (e.g., Paola et al., 1999). Is there an optimal width to manage for, above which channel width is less likely to be self- maintaining (higher risk of vegetation establishment), particularly in drought years? Think of large floods as free work but recognize that the system will adapt to the average / annual hydro-sediment regime. How will the system evolve after a (flood) bump?
- ***We recommend greater investment in calibrating hydraulic models and improving morphodynamic models at the reach scale using existing data, as this would create robust predictive tools for decision makers.*** The LIDAR dataset is one of the most extensive that we're aware of (worldwide) for modeling flow-vegetation-sediment interactions, and the potential for application of the field data in a modeling context will only grow with the addition of grain size information to be collected from unmanned aerial vehicle platforms.
- The machine-learning model is a big step forward in integrating available data.
    - Most of the output that we've seen from this model is averaged over the entire AHR (e.g., mean MUCW). We recommend generating outputs for the machine-learning model for different reaches along the AHR, as this would generate more insights useful for management. Is this possible using the current machine-learning model?
    - What combinations of conditions (predictors) would be useful to improve the machine-learning model but have not occurred historically? For example, would it be worthwhile to consider water releases to increase the variation that you've already seen based on natural flows?

Extension Big Question #2: How effective is Program management of Phragmites for maintaining suitable whooping crane roosting habitat?

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 2?

ISAC recommendations for EBQ 2

The ISAC recommends that the Program conduct additional research to address EBQ 2. It is worthwhile to continue to collect data showing *Phragmites* responses along gradients of herbicide treatments and flow (which is the design of the current study).

Additional ISAC comments for EBQ 2

- Keep in mind the ratchet effect: once vegetation like phragmites and cottonwoods establishes in the river bed, the impacts are not easily reversed. Vegetation increases in a step-like manner (EBQ 2) following a pause in inundation flows (EBQ 1), leading to reduced efficacy of future inundation flows. This is in contrast to the incremental effect of the no sed-aug experiment. Think of *Phragmites* as a super-ratchet.
- Consider analyzing general trends from remote-sensing data either instead of or in addition to careful consideration of individual patches of *Phragmites*. Is it possible to use morphological patterns as a proxy for vegetation type? If inundation flows were successful in maintaining MUCW, can we assume the dominant vegetation type was cottonwoods and willows? If inundation flows were unsuccessful, can we assume the presence of *Phragmites* and plan to spray? Is patch expansion the key metric to monitor, or ΔMUCW, or both? Is there an inverse correlation between patch expansion and ΔMUCW?
- There is stronger evidence that water can help to suppress plants and maintain MUCW than evidence that water can attract WCs in spring. The former has a long-term benefit for WC habitat, while the latter may or may not have a temporary benefit for WC stopping in the AHR. Perhaps the Program should consider waiting until completion of analyses of the WC telemetry data before using any more EA water for WCs in spring.

Extension Big Question #3: Is sediment augmentation necessary to create and/or maintain suitable whooping crane habitat?

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 3?

ISAC recommendations for EBQ 3

The ISAC recommends that the Program conduct additional research to address EBQ 3. The current no sediment-augmentation experiment should provide useful information under new conditions. See ISAC question 2, below, for additional recommendations.

Extension Big Question #4: What factors influence WC decision to stop or fly over the AHR?

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 4?

ISAC recommendations for EBQ 4

The ISAC recommends that the Program conduct additional research to address EBQ 4.

Additional ISAC comments for EBQ 4

- Stopping time has been shown to be an important predictor of WC stopping decisions. At the July meeting, it was suggested to only include observations during the late afternoon/early evening in the analysis. This approach could bias the analyses and would use an arbitrary rule to throw out some of the data. We recommend against such an approach.
- As noted above under EBQ2, using water to maintain MUCW may have a longer term benefit than using water to attract WCs to stop. Both functional relationships (i.e., MUCW vs inundation flows; and WC stopping vs flows) need to be better understood. If MUCW is more correlated with WC stopovers than flow metrics, then that would point to using water for maintaining MUCW rather than to attract WCs to stop.

Extension Big Question #5: What factors influence WC stopover length within the AHR?

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 5?

ISAC recommendations for EBQ 5

The ISAC recommends that the Program conduct additional research to address EBQ #5.

Additional ISAC comments for EBQ 5

- Given that the WC telemetry program is winding down, how does the Program propose to address EBQs #4 and #5 in the future? **The ISAC recommends that the Program develop a contingency plan for when the telemetry study ends in case there isn't a definitive answer to EBQ #4 and #5.**
- Should the Program consider manipulating conditions to increase contrasts? Data signal for EBQs #4 and #5 is likely to be weak. Manipulating conditions that can be influenced while telemetry data are rich would mitigate the risk of little variation in something like flow.
- It will be useful to compare WC stopover patterns on the Platte to stopping patterns on the Niobrara, Elkhorn and the Loup. The ISAC supports the EDO plan to use the telemetry data to compare behavior on other local river systems, if the provided data have sufficient sample size to support such an analysis.
- Use care when interpreting results for stopover length. In other studies on multiple species, researchers have inferred habitat quality based on time at a stopover site. However, this is

a correlational relationship. Stopover length may be due to other factors such as poor quality habitat requiring WC to stay longer to forage.

- The EDO continues to imply that only the telemetry data are useful to answer EBQ 5. Note that both the telemetry data and the non-telemetry data are helpful for addressing EBQ #5 (see the ISAC report on the Feb 2024 SPRS).

Extension Big Question #6: Why is Spring WC use of the AHR greater than Fall use?

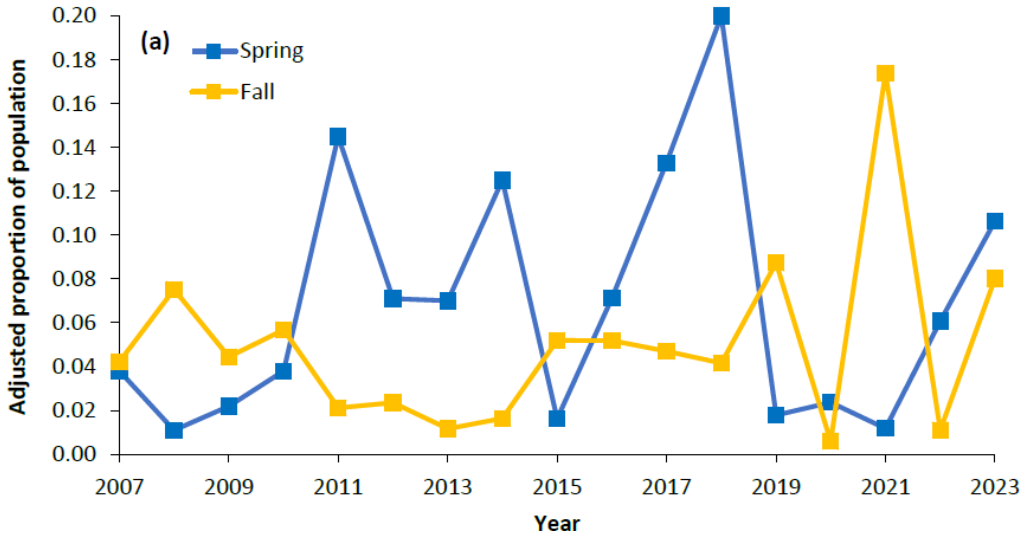
ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 6?

ISAC recommendations for EBQ 6

The ISAC does not support additional research to address EBQ #6. It is no longer clear that spring WC use is greater than fall WC use. As the ISAC noted in our report on the Feb 2024 SPRS, the Program could address seasonality under EBQ #4 and #5, and then remove EBQ #6.

Additional ISAC comments for EBQ 6

- **Use all the data:** In the reframe document (05 - PRRIP EBQ Reframe for TAC and ISAC) which was produced in 2024, the legend for EBQ 6 says the data are from 2002-2020. Is this a typo? It is important to include the data from 2022 and 2023.
- **Use the most appropriate plot.** In the Reframe document a plot of mean discharge vs proportional use was used (one for fall and one for spring). These figures make it challenging to compare spring vs fall use, which is the point of EBQ6. In previous reports, the plot below was used which is a much clearer comparison between fall and spring.



Extension Big Question #7: What effect do Program flow management actions to benefit WC, PP, and LT in the central Platte River have on pallid sturgeon use of the lower Platte River?

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 7?

ISAC recommendations for EBQ 7

Pallid Sturgeon genetics, use of the Platte, and spawning research is ongoing and a hydraulic model for the lower Platte River is under development. ***The ISAC recommends that the current research on Pallid Sturgeon be continued as planned.***

Additional ISAC comments for EBQ 7

- As noted in the ISAC on the Feb 2024 SPRS, ***the ISAC recommends that hydraulic models should include temperature, as Pallid Sturgeon movement and spawning are correlated with temperature.*** A 1D HEC-RAS model to examine changes in temperature as a function of Program water management in the Platte River would be helpful, as it was for evaluating advection-dispersion-development of pallid sturgeon embryos in the Upper Missouri River[1]. Jon Spurgeon noted at the July 16 TAC meeting that patterns of pallid sturgeon movement were similar in spring 2023 and spring 2024 despite much higher flows in 2024 (slide 4 of UNL update_July 2024), and commented that these patterns suggested that the movement of pallid sturgeon was likely more sensitive to temperature than flow. The Program should include evaluating potential temperature effects along with flow as part of steps 2 and 3 in the PRRIP water management study.
- Learning Objectives:
    - Current focus of University of Nebraska research is mostly on Learning Objective 1. If the researchers find a potentially reproductive female, they follow her as much as possible (objective 3). The ISAC supports this approach.
    - Observing 2 spawning events (one in 2023, one in 2024) is a big step forward. Close coordination with the Missouri River Recovery Program will maximize the chances of further confirmations of spawning, since the MRRP has an intensive program of active tracking of telemetered fish, and a substantial effort at trawling for age-0 sturgeon below the confluence of the Platte River and the Missouri River.
    - Now that the focus of the UNL research is on Learning Objective 1, should the Program re-examine the Learning Objectives for the pallid sturgeon habitat and spawning research?
- Add turbidity to the list of habitat metrics: "Identify habitat metrics (depth, velocity, temperature, etc.) that affect pallid sturgeon use and spawning behavior in the lower Platte and its tributaries."

[1] See https://ascelibrary.org/doi/10.1061/40737%282004%29404, https://onlinelibrary.wiley.com/doi/abs/10.1002/rra.3371 and https://www.nwo.usace.army.mil/Missions/Civil-Works/Missouri-River-Recovery-Program-MRRP/Fort-Peck-Test-Flows/

Extension Big Question #8: How much of an effect does predation have on PP productivity (fledging)?

Extension Big Question #9: How effective is Program management at mitigating losses of PP productivity due to predation?

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 9?

ISAC recommendations for EBQ 8 and 9

The ISAC recommends that the EDO conduct 1-2 more seasons of data collection to investigate EBQ #8 and #9. Since these studies were in the planning stage the ISAC has noted that the large differences between locations and natural annual variation may lead to considerable uncertainty for these studies.

Off-channel sand and water (OCSW) habitats may be more sensitive to predation. The Program will likely need to continue some sort of predation control at all OCSW sites. ***The ISAC recommends that the Program examine costs and benefits to determine the most cost-effective type of predator control at OCSWs.***

The ISAC recommends a comparison between the rates of predation in the Platte OCSWs with rates on the Missouri River in-river emergent sandbar habitats (ESH). If predation rates are similar to other systems, then it may be OK to accept a certain amount of predation mortality and to stop research on EQB #9. If predation rates are significantly higher in the Platte OCSW than Missouri ESH, then it is worth continuing this research for a few more years to further understand these patterns and the most cost-effective means of reducing predation mortality rates.

Additional ISAC comments for EBQ 8 and 9

- Suggested data sources on PP predation on other systems include the USGS and the MRRP (Chantel Hofer and Shelly Mcpherron).
- "The USFWS agreed that existing OCSW and MCA habitats are sufficient to meet the Program's existing and future obligation to benefit the piping plover unless use and/or productivity drops below an acceptable level (undefined)" (underline added). It is critical to define the acceptable level of productivity in order to know if the trend is approaching a critical level. The number of breeding pairs and fledging ratios continue to be useful indicators.

Extension Big Question #10: Wet meadows research *(NOTE: this is a carryover task from the First Increment to specifically address the physical processes involved in wet meadow hydrology)*

ISAC Question: Do we know enough already to estimate relationships (with confidence) and stop focusing on EBQ 10?

ISAC recommendations for EBQ 10

The ISAC supports the proposal to stop focusing on EBQ 10. ***We recommend that the Program make the edits to the wet meadows report as recommended by the peer reviewers and then produce a final Program report.*** The sooner that this is completed, the better.

Wet meadows can benefit many species. ***The ISAC recommends that in the Second Increment, the Program consider examining the costs and potential benefits of enhancing some of the wet meadows which have groundwater depths close to those required for self-sustaining wet meadows, using the extensive model developed as part of the Program's wet meadows research.***

ISAC Question 2: Sediment Augmentation

Does the experimental design / monitoring plan for the No Augmentation Alternative set the Program up for rapid and useful learning during the next five years, especially in comparison to the previous five years of implementation of the Full Augmentation Alternative?

ISAC recommendations for ISAC Question 2

The No Augmentation Alternative's monitoring plan is generally well designed. The 5-year experiment has the potential to provide some useful contrasts with the preceding augmentation period to inform decisions about sediment augmentation. We provide our recommendations ***(in bold italics***), along with the rationale behind them. In the Technical Recommendations section we provide more detailed recommendations that may be of use to Program technical staff and scientists.

Because this is a system-scale experiment, ***we recommend accounting for confounding environmental and geomorphic factors in your analyses,*** including (1) potential differences in flow between the augmentation and no-augmentation periods, and (2) potential lag time between the cessation of sediment augmentation and the emergence of observable geomorphic change. Accounting for these confounding factors will be important in drawing conclusions regarding the efficacy of the no-augmentation experiment.

A multi-decade "no-augmentation" experiment has already been performed on the J2 reach (i.e., the period between installation of the J2 return and the onset of sediment augmentation). ***To the extent that it's feasible, we recommend comparing geomorphic change during the no-***

augmentation experiment with the rate and pattern of pre-augmentation change to determine whether the multi-year augmentation approach "buffered" the system against incision when augmentation is stopped. Given the reduced volume of data during the historic pre-augmentation period, a quantitative/volumetric approach may not be possible, but even a qualitative comparison would be valuable. ***We recommend a comparison of sediment transport rates and bed dynamics along the channel downstream of the J2 return to those along a control reach (e.g., the N. Channel or downstream of Overton); this would be useful for assessing how and by how much J2 channel dynamics differ from those of a steady-state channel.***

What is the "off switch" for the no-augmentation experiment? ***The Program should explicitly identify the guidelines for making annual decisions regarding continuation, cessation, or alteration of the No Augmentation experiment.*** Perhaps purposefully, the decision on whether to continue the no-augmentation approach is ambiguous in the monitoring plan. ***We recommend that the Program establish quantitative and spatial metrics for whether, and when, to end the No Augmentation experiment early if needed.*** This might be as simple as specifying a simple magnitude/location threshold (i.e., "if x meters of bed incision are observed at location y, then the experiment will be ended"). The Program may prefer to have a series of thresholds (e.g., A - no concern, B - some advancing incision but acceptable, C - advancing incision, early warning of potential cessation of the No Augmentation experiment, D - unacceptable level of incision).

Additionally, regarding the design of the no-augmentation experiment, ***we suggest the Program go further than attempting to answer the question 'does sediment augmentation work?'***. Instead, present the results in terms of the volume of bed degradation with and without sediment augmentation. We hypothesize that given the confounding factors discussed above, the magnitudes and trends of change across the five years of this upcoming experiment will likely be non-linear and exhibit annual variability. That is, things may be messy and it's quite possible that after a relatively short five years, being able to say with confidence whether continued augmentation is necessary might not be possible. ***We therefore recommend that the Program use available sediment models and data (with a range of assumptions for various uncertainties) to simulate the No Augmentation experiment for two purposes: 1) to determine appropriate thresholds; and 2) to assess the ability to detect exceedance of those thresholds (essentially a statistical power analysis).*** The Program has demonstrated excellent and nuanced geomorphic data analysis to date in terms of geomorphic change detection and sediment budgeting, and similarly thorough work should continue as this experiment progresses.

Finally***, we continue to find the objectives for management in the J2-Overton reach ambiguous and suggest the Program clarify the desired outcome within this area***. Is the goal to prevent degradation of the Platte River channel at/downstream of Overton? Or is the goal to build and maintain habitat in the J2 return channel? The goal of the Program should be clearly defined, as it will set the need for and importance of sediment augmentation going forward, and help to define appropriate thresholds. Traditionally, J2 was a sacrificial reach. However, there is now crane use upstream of the Overton bridge, and with that use a decision needs to be made as to whether the goals of the Program should be updated to maintain the available habitat in the J2 reach. If crane habitat along the J2 return channel is a priority, then channel planform is an important consideration. If crane habitat is not a priority, then braiding for the sake of braiding isn't a goal for the Program, and an evolution towards an equilibrium channel along the J2 reach is what matters, regardless of planform.

ISAC Question 2 Technical Recommendations

Sediment Transport and Morphodynamic Modeling.

- If you used a sediment transport model to simulate the no-augmentation experiment, what's the probability of exceeding the KPI threshold (e.g., propagation of incision past Overton) over different durations of time? What is an acceptable probability? 0.1? 0.2? 0.5?
- Quantifying morphodynamic differences between the no-augmentation experiment and mechanical augmentation (MechAug) will be confounded by differences in flow between the two time periods. Can you use sediment transport modeling and/or statistical methods to somehow "filter out" the effects of flow? Would you be able to use sediment transport modeling to generate a graph showing some metric of annual channel incision on the y-axis (perhaps percent of channel with incision > x meters) versus some metric of "flow" on the x-axis (perhaps maximum annual flow, or simply the annual release volume), with two lines, one for the NoSedAug scenario, and one for the MechAug scenario? This graph would then act as a formal prediction of what you expect to occur over the 5-year period. Then you could use statistical analyses of the empirical data that you collect over the next 5 years to test this prediction, and thereby make improvements to both your understanding and your sediment transport model.
- On pages 5-6, you say that you're unable to make predictions of short-term incision due to data gaps. Wouldn't you still be able to make a prediction of relative changes in incision rates under no-augmentation versus mechanical augmentation based on sediment transport modeling (with uncertainty), for a range of reasonable assumptions to fill missing data gaps?

Geomorphic Change and Topographic Data Analysis

- There will be a time lag in response and the largest response will likely be further upstream. Further downstream you might have a slug of sediment moving downstream which is the result of transport occurring immediately below the J2 return. We suggest splitting the J2 reach into sub-reaches and examining morphodynamics and volumetric change in each sub-reach.
- Thalweg deepening due to planform change should not be confused with overall channel degradation, as offsetting deposition might be occurring on, for instance, point or mid-channel bars adjacent to the thalweg. With this in mind, we suggest analyzing mean channel elevation in addition to the thalweg elevation analyses that you are doing.
- It will be useful, as per previous ISAC recommendations, to determine the relationship between lateral migration rates and channel sinuosity within sub-reaches to derive estimates of potential sediment recruitment via channel migration.
- It may be insightful to examine the areal fraction of the active bed that exhibits more than 9 feet of downcutting, rather than simply using the longitudinal location of this threshold value. In this regard, on Pg. 10: are increases in the area of DBG > 9' your Key Performance Indicator (KPI)? If so, what change in this area is acceptable or unacceptable? If the area of the 9' class increased from 4.62 to 15.94 acres during 2016-2022 WITH MechSedAug, then that suggests that this amount of change (1.9 acres per year) is acceptable to the GC. Clearly more change will occur under NoSedAug (assuming similar flows). So what level of change in this indicator is acceptable to the GC - 10 acres / year? 100 acres / year?

- Analyze and compare the dimensionless bed relief index (BRI*; Liebault et al., 2012: https://onlinelibrary.wiley.com/doi/10.1002/rra.2615) through time and longitudinally for J2 reach and a control reach.
- The depth of data analysis being conducted by the Program is impressive! At the same time, we fear that decision-makers often might lose track of the big picture within the many metrics, graphs and charts being presented. We suggest developing a robust repeat photography effort for locations at/near the J2 channel. Ideally, local photograph archives (UNK, UNL, etc.) could be searched for historic photographs of the reach, perhaps as a student project, and matched with present-day photographs. Such efforts, though qualitative by nature, have been useful in river restoration and management programs. See, for instance, the repeat photography program used as part of the Glen Canyon Dam Adaptive Management Program (https://www.usgs.gov/centers/southwest-biological-science-center/science/southwest-repeat-photography-collection).
- The Program lacks a robust sediment budget analysis to assess the relative contributions of the North channel and the J2 return channel to Overton. If preventing incision and bed degradation downstream of Overton is the goal, the North Channel is likely the major contributor of sediment and its budget really needs to be incorporated into the analysis. As a simple analysis, we suggest estimating the 1D sediment transport rate in the North Channel and comparing this to that in the J2 channel. Secondarily, would it be possible to back-calculate the North Channel sediment input, given that the sediment budget at Overton and the sediment budget of the J2 channel are known?
- When conducting volumetric change analysis, in addition to reporting the net value of change, it's important to also report the constituent values of erosion and deposition volumes. This was a peer review comment that was summarized for the sediment augmentation report, and we concur with that recommendation. As an example, it's possible to get a net sediment budget of 0 m^3, but simply reporting this number does not tell the reader if that resultant budget was because there was absolutely no change through the reach at all, versus potentially large (yet offsetting) volumes of scour and deposition.
- Normalise volume change analysis by flow to get a sediment flux per cubic meter of discharge, allowing direct comparison between years even though flows may be different.
- Similarly, we agree with the peer review comment on the sediment augmentation report that it's important to report on uncertainty in your DEM differencing. The rationale for not thresholding the change analysis is legitimate, but uncertainty is important in the science of change detection. Even if results are not thresholded, readers and managers will likely want to know how much thresholding would change the overall sediment budget story. Put simply, including these numbers will ensure the audience that the Program did its due diligence.

Larger-Scale Programmatic Efforts

- **Aspects of flow (magnitude, duration, rate of change) are just as important in river change as sediment supply; can changes in J2 flows be used in tandem with sediment augmentation to slow/stop degradation?** There is a great deal of work and effort being expended by the Program on the "sediment side" of Lane's balance (Figure 1 below) as it relates to geomorphic change in J2, but one thing that's conspicuously missing is any discussion of flow alteration that might preclude or slow channel incision and promote equilibrium. The magnitude and timing of discharge are just as important in shaping channel morphology as the volume and caliber of sediment available to a river, and we

encourage consideration of alternative operational regimes for the J2 hydropower plant, if possible, and whether they might be beneficial for the geomorphic aims of the Program.

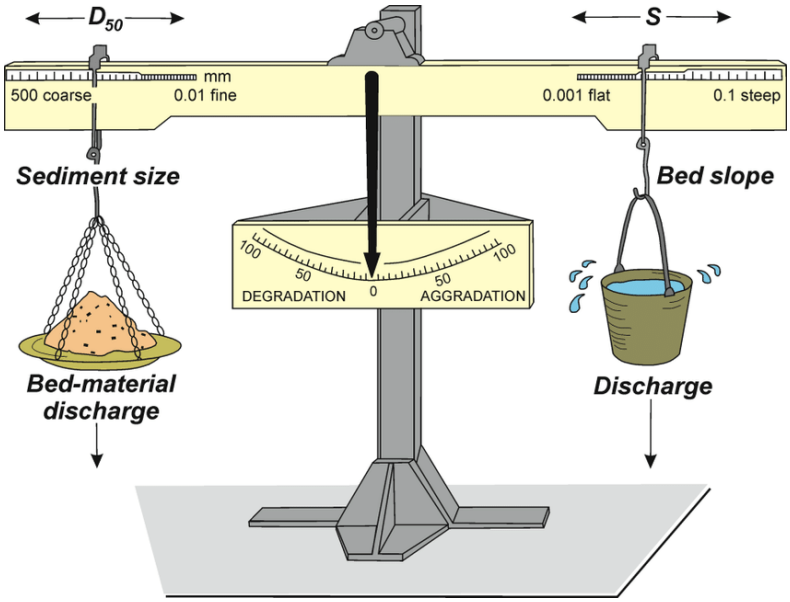


Figure 1: Illustration of Lane's Balance from Rinalidi et al. https://www.researchgate.net/profile/Massimo-Rinaldi-2/publication/283538764

ISAC Question 3: Whooping Crane (WC) Roost Site Selection Technical Report

Resource selection relationships (like the unobstructed channel width [UOCW] relationship in this report) could potentially be used in a Structured Decision-Making (SDM) framework to estimate resource allocation tradeoffs. How might the Program assess the uncertainty (i.e., interpret confidence intervals) in these relationships as they relate to expected WC response to increasing levels ($) of management? For example, how much confidence would you place in WC response to incremental increases in UOCW past 500 ft, 650 ft, 800 ft, 1,000 ft, etc.? What data would you use as SDM input for expected outcome? For example:

- Resource selection model results: 90% CI range, predicted value from the curve.
- Cumulative percentage of birds observed at 500 ft, 650 ft, 800 ft, 1000 ft.

We anticipate the GC will want to understand confidence in "bang for buck" across the range of modeled WC response to management actions.

ISAC recommendations for ISAC Question 3

ISAC Question 3 is likely related to the Feb 2024 ISAC report where the ISAC took issue with one sentence in the Roost Selection Report related to interpretation of confidence intervals. However, ISAC question 3 led to useful insights from the ISAC on related issues. Thus we have grouped the ISAC responses into three categories: biology, policy and statistics.

ISAC Question 3: Biological Issues

The ISAC recommends that the Program consider multiple lines of evidence when considering how to identify resource allocation tradeoffs in a SDM framework. Each modeling approach and data set has strengths and weaknesses. In addition to the Resource Selection model and crane use data that have long been used by the Program, we expect analyses of probability of stopping at the river and length of stay (EBQ 4 & 5) to provide useful insights to supplement what has been learned from the resource selection report.

Resource selection relationships developed in the Program report are useful for understanding what factors influence differential use of Platte River roost sites and what values those factors would need to be at to maximize site selection. The Program has used these results effectively in identifying what factors to manage (channel width, riparian forest setback) and inform management goals (e.g., UOCW ≥ 650 ft). However, resource selection relationships may not provide entirely satisfying inputs for expected outcomes in an SDM process because results are quantified in a way that does not lend themselves to easy interpretation. Specifically, the predicted values are expressed as relative use. For example, one can determine that 650 ft channels are X times (90% CI Y-Z) more likely to be used than 400 ft channels. These results provide less tangible information to understand tradeoffs, because it is difficult to prescribe biological value to "X times more likely to be used". Such limitations are inherent in estimating and interpreting resource selection and not technical failings of EDO staff or TAC members.

Analyzing crane use by river channel width categories (Appendix 3 of the WC Roost Site Selection Report) offers a more concrete understanding than resource selection models. However, this approach is not without its own drawbacks, as observed use is dictated by both habitat availability and crane presence. Cranes are unable to assess the entire Area of Habitat Requirements (AHR) in a single migration season or across multiple seasons. The fact that approximately 50% of crane roosts are located at sites with widths of 400-1000 feet reflects both the alternatives available at the time and the cranes' inherent preferences. For example, a person might prefer a red vehicle but end up purchasing a burgundy one if no red vehicles are available. This decision is a result of both innate preference and the options accessible at that moment.

The Program has been managing for UOCW of ≥ 650 feet. Is there any reason to change that? If you did increase the UOCW target, what percent of the Program-managed lands would support making such a wide channel? Perhaps the Program should consider a new management strategy such as: 650 feet minimum, with 1000 feet (or similar) in locations where the river can maintain such widths. If there were a decision to deliberately widen the channel in certain locations, there should be a careful experimental design to determine whether WCs preferentially select the widened channels. Testing this hypothesis will however be difficult, given the large amount of year-to-year variability in

the number of WCs which choose to stop on the Platte River. In addition, years with few WCs will not provide much information for testing this hypothesis.

ISAC Question 3: Policy Issues

The ISAC recommends that the Program demonstrate and report the impact of the PRRIP on channel widths managed for WC use on Program-managed land. The EDO should do analyses and/or provide plots to answer the following questions:

- In the Appendix 3 plot (08 - WC Roost Site Selection Report SPRS - FINAL.pdf), what percent of the roost and non-roost sites are managed by the Program?
- Which sub-reaches in the AHR have a UOCW of 650? Which of these are managed by the program and which are not?

Beyond statistical technicalities, ISAC Question 3 is really more of a policy question. The RSR model has identified which variables are important in correlation to WC selection. *If there is uncertainty in the Program as to whether the 650 ft UOCW target should be changed, then this question is appropriate for full SDM treatment*. As part of the SDM process, the EDO should provide a range of options with costs to the Program and benefits to WC. For example, which sub-reaches of the AHR could have an UOCW of 650, 800, or 1000 ft? How much would it cost to increase the UOCW to 1000 ft? Does the cost vary by AHR section?

ISAC Question 3: Statistical Issues

When appropriate, use advanced statistical tools like bootstrapping to make inferences using the Resource Selection model. See also, Appendix A and B below.

- It is appropriate to compute an interval for the Resource Selection Ratio (RSR) for a specific Unobstructed Channel Width (UOCW). For example, for a UOCW of 1000 ft, it is appropriate to compute a 95% Confidence Interval (CI) for the RSR.
- It is not appropriate to compute a confidence interval for a predictor in the Resource Selection model. The RSR model can't be used to answer: what is a 95% CI for UOCW when RSR is above 50%? Most regression-type models don't allow you to construct a CI for a predictor variable. The model doesn't include uncertainty in UOCW (a predictor) so that's why it isn't appropriate to compute CIs for the predictor.
- While a RSR model can't be used to create a CI for the UOCW, there are multiple approaches that are appropriate. For example,
    - Use bootstrapping: You can use bootstrapping to make inferences comparing the RSR for two levels of UOCW. Instead of computing two CIs and seeing whether they overlap, compute the difference in the estimated RSR and construct a bootstrap estimate for the CI of the difference. Then you can determine whether the CI overlaps 0. See more details in Appendix B below.
    - Consider multiple lines of evidence: As discussed under the biological recommendation, it can be useful to consider all forms of evidence. For example, consider using the percent of roosts to determine whether to change the UOCW. You can use the data from Appendix 3 of the WC Roost Site Selection Report, page 58, to show that
        - 64.1% of roosts have UOCW between 400 to 1000 ft, while only

        - 35.7% of available channel segments (100' bins) have UOCW between 400 to 1000 ft.
    - Note, we use the terminology for confidence intervals above, but the Program should use Prediction Intervals (PIs) when appropriate following standard statistical practice for the use of CIs vs PIs.

<u>Detailed recommendations related to the WC Roost Site Selection Report</u> (08 - WC Roost Site Selection Report SPRS - FINAL)

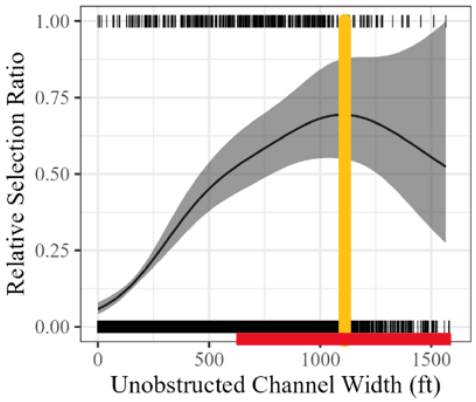
- ***We recommend that you do additional exploratory data analysis to understand the WC roost site selection data and suggest future models.*** We recommend the following plots/tables for starters, but you will likely think of others:
    a. It is important to report the percentage of sites for each landcover class for understanding the data and interpreting the output. For the appendix or perhaps Table 1, add "% of roosts" and "% of available" over all sites in the study area.
    b. For the predictors in Table 4 (predictors in the top model), it would be useful to see plots of each variable over all roost sites or available sites over time. For example,
        - Plot A: for all the available sites, make a boxplot for each year of Nearest Forest (NF) for available sites and plot (x-axis=year, y-axis= NF).
        - Plot B: repeat for roost sites
        - Questions/inferences: Has the median changed over time? How does the pattern/trend in plot A compare to plot B?
        - If these plots are all quite flat, then no need to consider these plots. But if there are big changes for one or more of the variables (e.g., NF over time), then this could increase your understanding of the model results.
        - If these are interesting plots, then create the same plot for each of the predictors mentioned in Table 2, even if they weren't selected as important (Table 4).
- ***For future analyses of Program data, we recommend that the Program consider Bayesian analyses when appropriate.***
    a. The Program used a frequentist analysis for the RSR model which mimics the previous similar analyses. That's fine. In the ISAC February 2024 meeting document the ISAC suggested that the EDO consider doing a Bayesian analysis for the RSR model. In the EDO response (09 – EDO Responses to ISAC Comments"), EDO wrote "Bayesian – gives you the same type of results for continuous variables, just with credibility intervals for uncertainty." This is not correct. With a Bayesian analysis, you can create the types of credible intervals that you want comparing the RSR for two UOCWs. Bayesian methods in general have many advantages over frequentist methods. One of the advantages is that you don't need to use bootstrapping or multiple comparison adjustments. You easily construct a credible interval for any function of the response using the Markov chain Monte Carlo output.
    b. While we thought it was important to increase the EDO understanding of Bayesian models here, we note that there are good arguments for not doing a Bayesian analysis for this problem since the EDO is comparing results to multiple previous frequentist Resource Selection function analyses.
    c. Bayesian models have many benefits and are now widely used for ecological and biological data analyses. We recommend that the Program consider Bayesian

analyses when appropriate for future analyses. This is generic advice, not advice tied to the RSR model.

- Omit Figure 8. As noted in line 565 "We then predicted relative selection ratios and 90% confidence intervals between the fifth and ninety-fifth percentile of each explanatory variable to avoid extreme predictions at the end of variable distribution" (underline added). You are correct and this follows best practices. However, Fig 8 includes the unobstructed channel width across the entire range of 720 unobstructed channel widths. Omit Figure 8.
- Appendix 3:
    a. Replace Figure 6A with the figure in Appendix 3 main text. It tells a clearer story that birds are selecting roosts that tend to be wider than those that are available.
    b. For the roosts, how has this plot changed over time? Create new plots to demonstrate and understand habitat improvements due to the Program over time.
    c. For GC, TAC and EDO use, the following plots might also be useful
        - Shade the bars in Appendix 3 to show what proportion of each bar (blue and green) are Program lands. This is a useful plot to show the impact of the Program - the birds are using wider channels and the Program is making these wider channels.
        - Bang for the buck: A different version would be to add some sort of shading to the bars to determine what are the expensive areas to maintain.
    d. Detail, but important: In the caption to the Appendix 3 figure use the exact same wording to describe the variables that are used as the row headers in the table in Appendix 4. This reduces confusion for the reader who is also looking at the table in Appendix 4.
- Appendix 4:
    - "Total Percent of Roosts": Omit this row. There is no evidence that you should make more habitat at 0-100 UOCW, for example. However, if you do include this row, then correct the label. "Total Percent of Roosts" should be "Cumulative % of roosts".
    - Transpose this table so we can easily compare numbers in one column. It is best practice to line up the numbers you are comparing to be in a column so you can easily skim down the column and find the big numbers, for example. This is impossible to do in the current format.

Report continues on next page

Appendix A: More details on appropriate use of the RSR model:



- What are appropriate uses of the resource selection function model?
- Appropriate: for a specific UOCW, what is a 95% CI (or PI) for the Relative Selection Ratio (RSR)?
- Can't do: what is a 95% CI for UOCW when RSR is above 50%?
- Can't do: what is a 95% CI for UOCW around the maximum RSR?

Appendix B: More details on the bootstrapping approach:

Figure 9 below is from the Roost selection report. It is useful to compare the results from the latest analysis to the 2017 and 2019 analyses. Consider the yellow line Figure B (UOCW that maximizes the Relative selection ratio for the 2017 analysis, Baasch et al) and the red line in Figure C (corresponding value for the 2024 model). To compare the yellow and red lines, compute the difference in the relative selection ratio at the two unobstructed channel widths. Then use bootstrapping to compute a CI for the difference (or PI as appropriate).

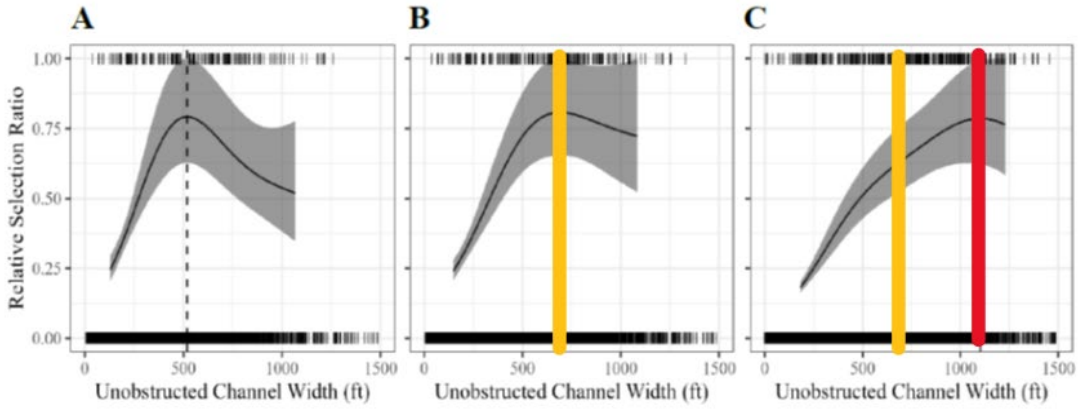


Figure 9. Predicted relative selection ratio of unobstructed channel width (UOCW) estimated from whooping crane roosts collected by systematic aerial monitoring from Howlin and Nasman (2017; A), Baasch et al. (2019a; B), and the current study from spring 2001 – spring 2022 on the central Platte River in the Associated Habitat Reach (C). The selection relationship for Howlin