WHOOPING CRANE RIVERINE ROOST SITE SELECTION UPDATE

QUESTIONS FOR ISAC

1) Given the results from analysis step 2, what are next steps to explain similarities/differences seen in whooping crane selection patterns?
2) How do on-channel and off-channel metrics influence each other?
3) Can you suggest an appropriate way to integrate all explanatory variables into the model selection process? A way to observe how on and off-channel metrics may influence each other?
    a. A previous investigation considered a suite of on-channel and off-channel metrics and only combined important variables from separate model selection processes (https://platteriverprogram.org/document/correlates-whooping-crane-habitat-selection-and-trends-use-central-platte-river).
    b. What valid methods (exploratory analysis) would be appropriate to inform variable combinations in model development for selection?

INTRODUCTION

As indicated in the Extension Science Plan, an updated whooping crane riverine roost site selection analysis was initiated in 2022 as a First Increment Big Question check in activity. The previous investigation used whooping crane riverine use location data from 2001 through spring 2017 and found unobstructed channel widths of ≥ 200 m (~650 ft) and nearest forest of ≥ 165 m (~550 ft), leading to an unforested corridor width of ≥ 330 m (~1100 ft) were important for riverine roost site selection (Baasch et al. 2019). This investigation was limited to in-channel explanatory variables to inform Program land management efforts for whooping cranes. The updated analysis included 10 more migration seasons of use and available locations from fall 2017 through spring 2022 and include both in-channel and off-channel explanatory variables. Including whooping crane data from fall 2017 – spring 2022 was important for two reasons.

1. A similar number of use locations were identified during fall 2017 – spring 2022 migration seasons as were observed over the previous 15 years (2001 – Spring 2017; Figure 1).

2. Average unobstructed river channel widths throughout the Associated Habitat Reach were wider and more favorable for whooping crane roosting from fall 2015 through spring 2022, which was contrasted by more limited availability prior to fall 2015 (Figure 2).

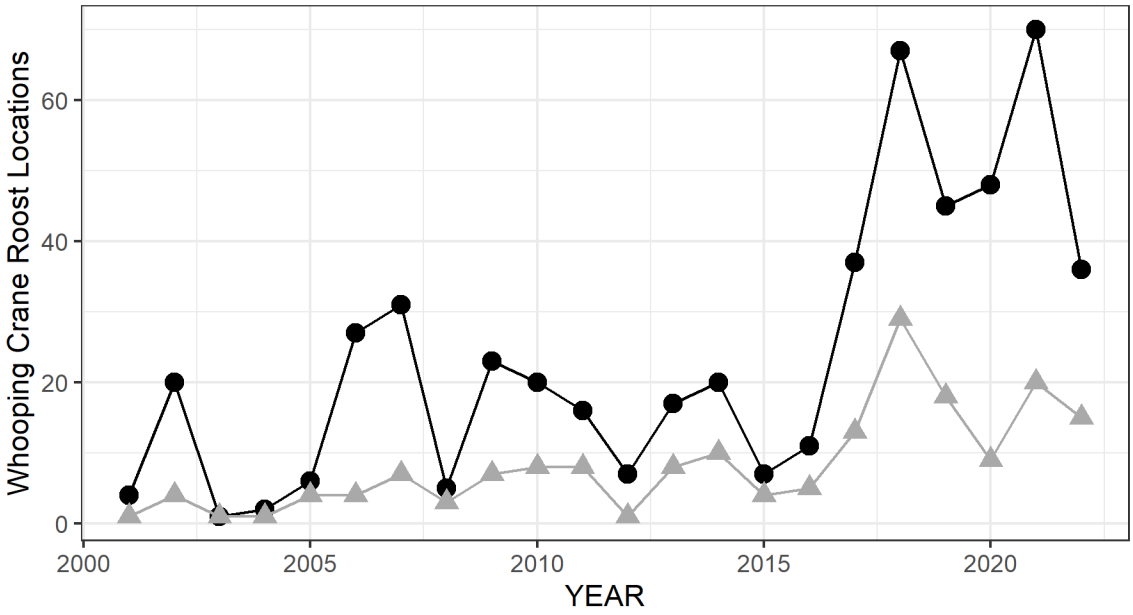

Figure 1. All systematic whooping crane riverine roost locations (circles) and unique first systematic observations (triangles) from 2001 – 2022 included in analysis update.

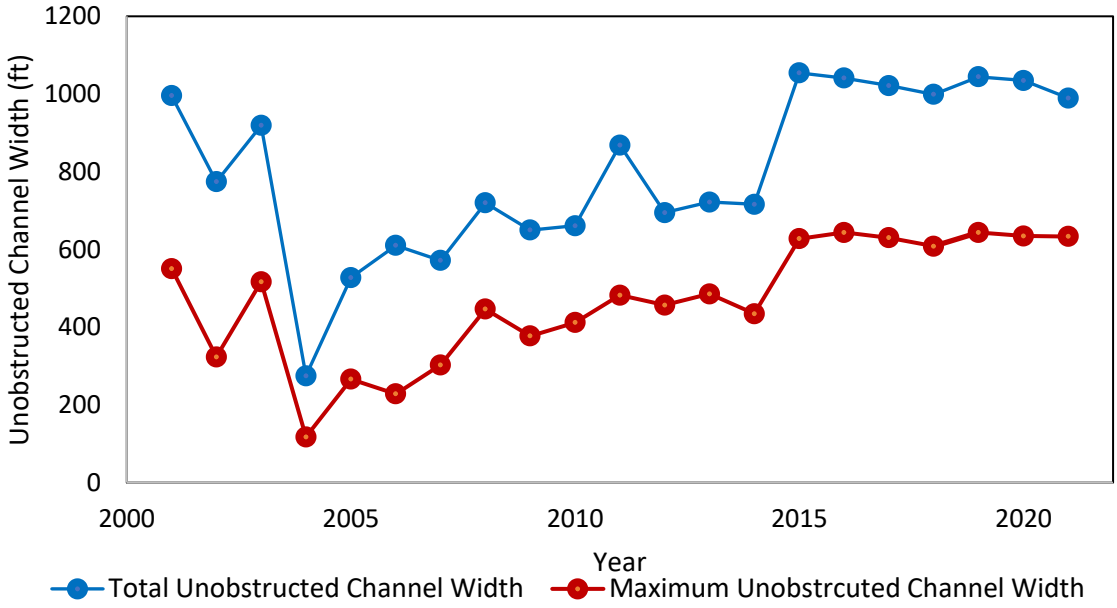

Figure 2. Average total unobstructed channel width (TUCW) and maximum unobstructed channel width (MUCW) from 2001 – 2021 throughout active river channel within the Associated Habitat Reach.

Our *objectives* were to:

A. Identify if unobstructed channel width and nearest forest are still the most important in-channel variables to explain riverine roost site selection. If so, are predicted relationships still similar?

B. Understand if off-channel landcover influences riverine roost site selection.

METHODS

- Multiple whooping crane riverine roost location data sources over a 22-year time span within the Program's Associated Habitat Reach.
    - Program systematic aerial monitoring (unique locations = 164, total locations = 461; 2001 – Spring 2022)
    - Whooping Crane Cellular Telemetry Partnership (unique locations =16, total locations = 59; 2018 - 2021)
        - Discarded any telemetry locations also identified by aerial monitoring

- Explanatory variables
    - On-channel/off-channel metrics (Table 1)
    - Multiple data sources to represent the landscape and calculate explanatory variables (Figure 3)
        - Outside historical floodplain = Annual National Land Cover Data with specific crops (https://nassgeodata.gmu.edu/CropScape/)
        - Historical Floodplain =
            1. Rainwater Basin Joint Venture (RWBJV) land cover/land use (Brei and Bishop 2008)
            2. National Wetland Inventory (NWI)
            3. USDA-NCRS flooding frequency data
        - Active river channel = LiDAR vegetation classification
            - Fall 2017 – Spring 2022: LiDAR supervised classification of identify sand, water, and vegetation height.
            - 2001 - Spring 2017: LiDAR supervised classification of sand and water and RWBJV product in-channel land cover/land use.

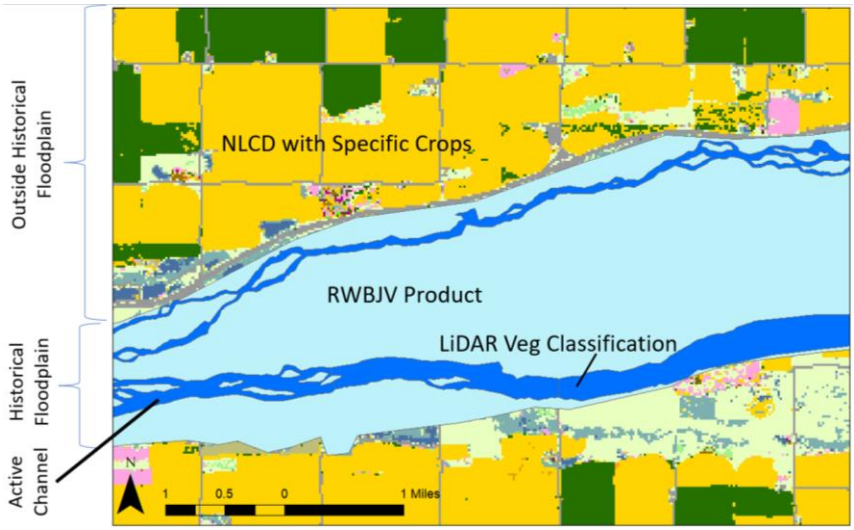

Figure 3. Landscape extents and data sources for the whooping crane roost site selection update. Landscape alternations from Program management activities, including river channel disking and tree clearing, were also accounted for when deriving explanatory variables.

- Statistical analysis
  - Methods:
    - Discrete-choice resource selection study design (Baasch et al. 2019)
      - Use = systematically collected riverine roost locations
      - Available = 20 random riverine points within 10 miles of use location
    - General Additive Models with limited degrees of freedom for variable relationship shape as to not overfit to training data (Wood 2006).
  - Model selection process (with numbered analysis steps)
    - All model selections employed Akaike Information Criterion adjusted for small sample size (AICc) to identify important metrics, which were those from the most parsimonious model(s) with ΔAICc ≤ 2.0 (Burnham and Anderson 2002). Only unique observations were used in model selection, as subsequent observations from the same crane group were not independent.
    - On-channel metrics only
      1. Reproduced Baasch et al. (2019) results
      2. Identify important metrics from (a) 2001 – Spring 2022, (b) 2001 – Spring 2015, and (c) Fall 2015 – Spring 2022 using relevant variable combinations from Baasch et al. (2019).
    - Off-Channel metrics only
      3. Identified important off-channel metrics for each period (a-c) by comparing models with each off-channel metric as a single explanatory variable.
    - On/off-channel metrics
      4. Combined most important on and off-channel metrics for each period (a-c) in final model selection process.

    - Final predicted relationships of riverine roost site selection and important metrics were derived from all systematic location data, which included both unique and subsequent observations of crane groups.

RESULTS

- All in-channel model selections found nearest forest and unobstructed channel width to be important (Table 3, Figure 4).
- Unit discharge was important for in-channel analyses which included whooping crane data from fall 2015 – Spring 2022 (Table 3, Figure 4).

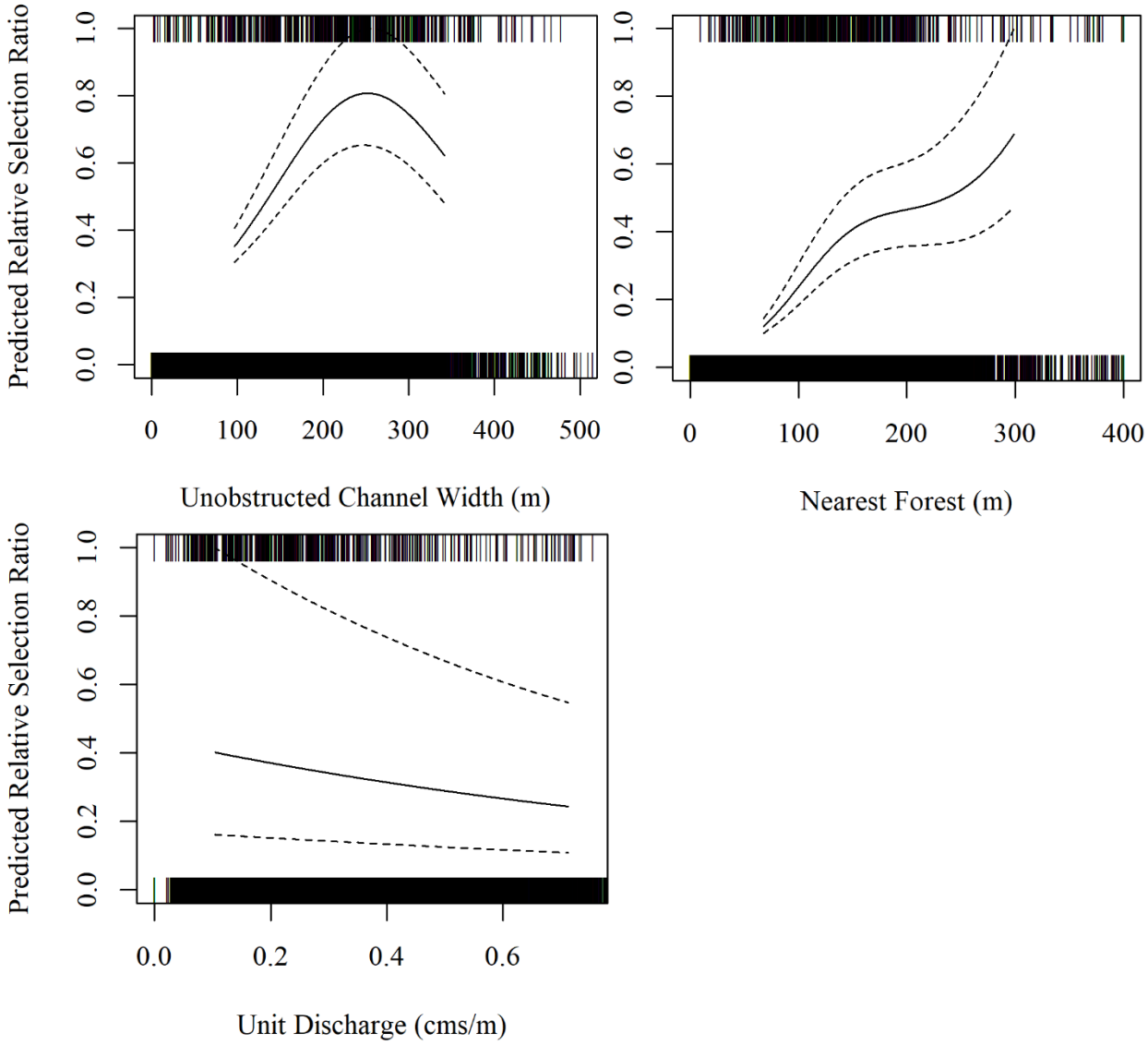

Figure 4. Predicted relative selection ratio (solid line), with 90% confidence intervals (dashed lines), between use location 10th and 90th percentiles of unobstructed channel width, nearest forest, and unit discharge based on whooping crane locations and available locations from fall 2015 – spring 2022. Tick marks display response data (use locations are plotted at y = 1; available locations are plotted at y = 0).

LITERATURE CITED

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TABLES

Table 1. On-channel and off-channel explanatory variables for inclusion in riverine roost site selection analysis.

Explanatory Variable	Description
On-Channel Metrics	
Unobstructed Channel Width (UOCW)	Width of active channel unobstructed by tall vegetation or wooded islands measured perpendicular to the historical floodplain the channel at use or available location.
Total Channel Width (TCW)	Total channel width of channel from left bank to right bank measured perpendicular to the historical floodplain at use or available location. Total distance from left to right bank station: 1-D HEC-RAS model.
Nearest Forest (NF)	Distance to nearest riparian forest measured from use location or available point in any direction.
Unforested Corridor Width (UFCW)	Width of corridor (not confined to active channel) unobstructed by riparian forest measured perpendicular to the historical floodplain at use or available location.
Unit Discharge (UD)	Flow (cfs), extrapolated from nearest gage (Overton, Kearney, Grand Island), per linear foot of wetted channel width.
Off-Channel Metrics	
Grassland	Proportion of buffer area covered by all combined grassland classes.
Prairie	Proportion of buffer area covered by prairie.
Wet Prairie	Proportion of buffer area covered by wet prairie.
Meadow Marsh	Proportion of buffer area covered by meadow marsh.
Forest	Proportion of buffer area covered by forest.
Agriculture	Proportion of buffer area covered by agriculture of any type.
Corn	Proportion of buffer area covered by corn.
Soybeans	Proportion of buffer area covered by soybeans.
Alfalfa	Proportion of buffer area covered by alfalfa.
Other	Proportion of buffer area covered by other agricultural crop.
Agricultural Wetlands	Proportion of buffer area covered by agricultural wetlands.
Developed	Proportion of buffer area covered by anthropogenic development (roads, parking lots, buildings, infrastructure, etc.).
Distance to Development	Distance to nearest developed landcover type (see above definition) measured from use or available location in any direction.
Distance to Power Lines	Distance to nearest power lines measured from use or available location in any direction.
Length of Power Lines	Total length of power lines within buffer area.

Table 2. Data sources for explanatory variables through time.

On-Channel Metrics			
	2001-2017	**2017-2022**	**2001-2022**
Unobstructed Channel Width (UOCW)	Hand-delineated	LiDAR veg classification	Hand-delineated + 1-D HEC-RAS model + LiDAR veg classification + NLCD
Total Channel Width (TCW)	1-D HEC-RAS	1-D HEC-RAS model OR 2-D Hydrodynamic model	
Nearest Forest (NF)	Hand-delineated	LiDAR veg classification + NLCD[a]	
Unforested Corridor Width (UFCW)	Hand-delineated	LiDAR veg classification + NLCD	
Unit Discharge (UD)	1-D HEC-RAS model	1-D HEC-RAS model OR 2-D Hydrodynamic model	1-D HEC-RAS model
Off-Channel Metrics			
	2001-2013	**2014-2022**	**2001-2022**
Grassland	RWBJV[b] Product + NWI[c] + flooding frequency	NLCD	RWBJV Product + NLCD + LiDAR veg classification *2001-2017: on-channel landcover/veg classification poor
Forest		NLCD + LiDAR veg classification	
Agriculture		NLCD (CropScape)	
Developed		NLCD	
Distance to Development		NLCD	
Distance to Power Lines		Dept of Energy	Dept of Energy
Length of Power Lines			

[a]NLCD = National Land Cover Data

[b]RWBJV = Rain Water Basin Joint Venture

[c]NWI = National Wetland Inventory

136 **Table 3.** Important explanatory variables identified in each analysis step to explain whooping crane
137 riverine roost site selection.

		On-channel metrics			Off-channel metrics
Analysis Period	**Analysis Step**	**Nearest Forest**	**Unobstructed Channel Width**	**Unit Discharge**	
2001 - Spring 2022	Analysis Step 2	X	X	X	
	Analysis Step 3	To be completed			
	Analysis Step 4				
2001 - Spring 2015	Analysis Step 2	X	X		
	Analysis Step 3	To be completed			
	Analysis Step 4				
Fall 2015 - Spring 2022	Analysis Step 2	X	X	X	
	Analysis Step 3	To be completed			
	Analysis Step 4				

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