Whooping Crane Stopovers versus Flyovers

Introduction & Background

- According to the Adaptive Management Working Group, one Big Question to answer during the extension concerns whooping crane decisions to stop in the Associated Habitat Reach (AHR) during migration. The specific big question states: What are the conditions that influence whether a whooping crane will stop or flyover the central Platte River?
- To answer this question, the Program is acquiring an evolving dataset of all telemetry-recorded whooping crane locations within a 62 miles buffer of the AHR from the Whooping Crane Cellular Telemetry Tracking Partnership since project initiation in 2017.
    - Data from this partnership consisted of individual telemetry equipped whooping cranes providing locational data every 15 minutes and provided the opportunity to assess conditions encountered when whooping crane initially stop in the AHR or flyover the AHR.

Cellular Telemetry Data and Variables

- The full dataset was constrained to interactions with the AHR and we defined a location to approximate when a stopover initiation decision was made or not. We used the last location recorded before a bird encountered active river channel within the central Platte River to spatially define the telemetry location where a stopover initiation decision was made. We measured potential explanatory variables produced from the Adaptive Management Working Group hypotheses based on these stopover initiation decision locations.
    - ***Main Channel Total Unobstructed Channel Width (ft)*****:** Average main river channel total unobstructed channel width calculated from channel width measurements taken between 1 mile upstream and downstream of closest active river channel point to the first AHR associated location. Channel widths were delineated at 436 transects spaced 1,000 ft apart within the Associated Habitat Reach.
    - ***Maximum Unobstructed Channel Width (ft)*****:** Average maximum unobstructed channel width calculated from channel width measurements taken between 1 mile upstream and downstream of closest active river channel point to the first AHR associated location. Channel widths were delineated at 436 transects spaced 1,000 ft apart within the Associated Habitat Reach.
    - ***Time of day*****:** Number of hours before dark (daily sunset plus 30 minutes) for the last location recorded before a bird encountered active river channel.
    - ***Instantaneous river flow (cfs*****):** River discharge recorded within 15 minutes prior to the last location recorded before a bird encountered active river channel.
    - ***Day of migration season*****:** Proportion of days into a migration season a first AHR-associated location occurred compared to the total migration season length as defined by the PRRIP whooping crane monitoring protocol.
    - ***Lowland grassland*****:** Proportion of landcover classified as lowland grassland within 1 mile radius of active river channel location closest to the first AHR associated location.
    - ***Development*****:** Proportion of landcover classified as human developed within 1 mile radius of active river channel location closest to the first AHR associated location.

Statistical Model

- A multivariable complementary log-log regression model will be used to test for associations between potential explanatory variables and AHR stopovers. We will compare models to identify best explanatory variable combinations using Akaike Information Criterion adjusted for small sample size (AICc) and calculated area under the precision-recall curve (AUC-PR) to evaluate model performance. AUC-PR is a model performance metric similar to area under the receiver operator curve but is more robust to unbalanced binary outcomes (Sofaer et al. 2019).[1]

Results

- We summarized the data thus far obtained from whooping cranes migrating through the Associated Habitat Reach from Fall of 2017 – Fall of 2020.
    - A total of 131 migration events from 51 individual birds were identified within 62 miles of the AHR. One hundred and seventeen events from 49 individual birds interacted with the Associated Habitat Reach, which is 2-3 migrations per individual on average.
    - Birds 0A and 2A provided the most migration events (n = 7) and provided location data during every migration season during the data collection period.
    - Only five AHR migration events occurred in fall of 2017, 16 in 2018, 43 in 2019, and 53 in 2020 (Figure 1).
    - Eight percent (9 stopovers/ 117 migration events) of AHR migration events resulted in stopovers within the AHR. Five stopover events occurred in fall 2019 and constituted the most stopovers during a single, unique migration season to date (Figure 1).

[1] Sofaer, H. R., J. A. Hoeting, and C. S. Jarnevich. 2019. The area under the precision-recall curve as a performance metric for rare binary events. Methods in Ecology and Evolution 10:565–577.

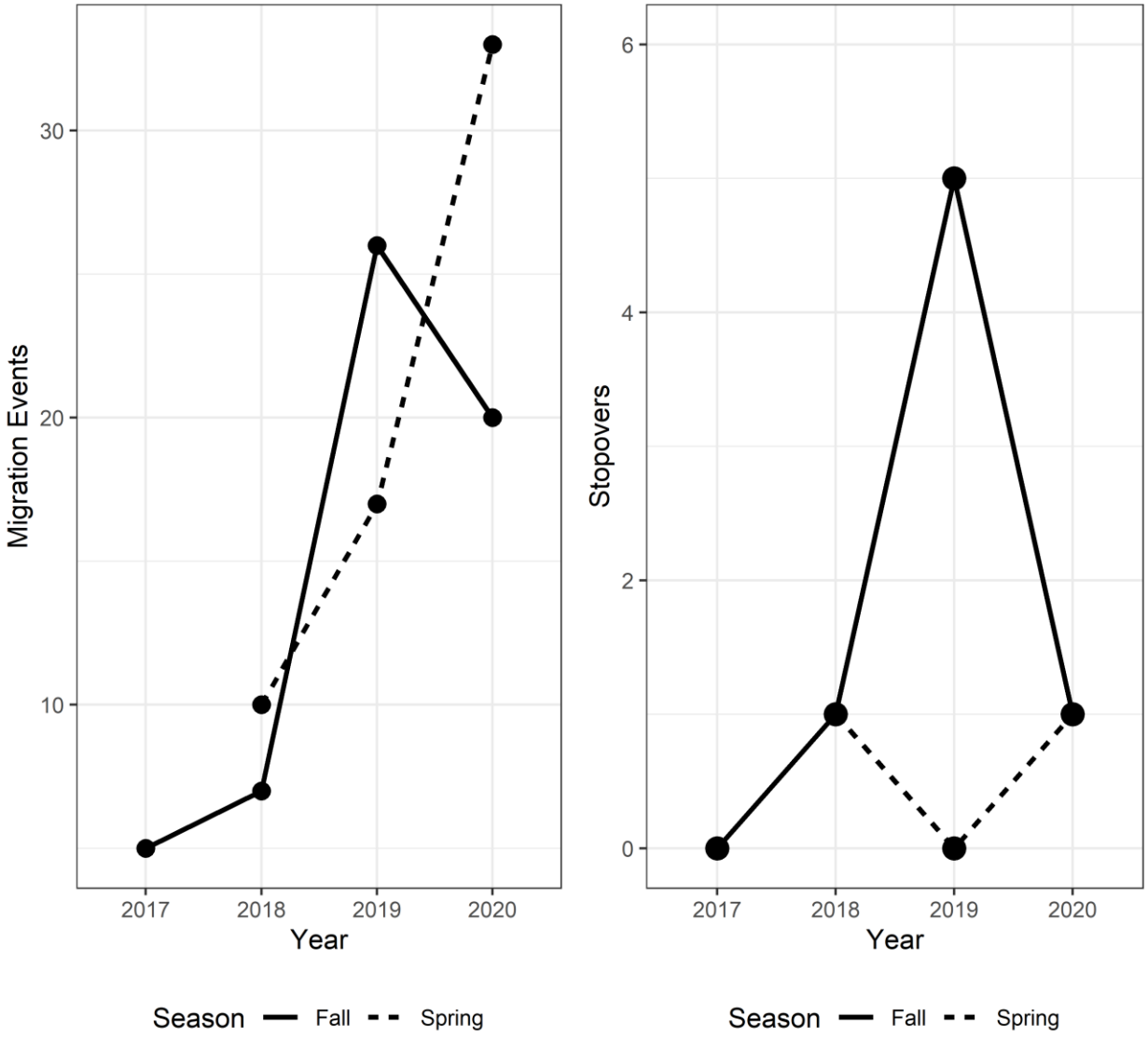

Figure 1. The number of cellular telemetry equipped whooping crane total migration events (left) and stopovers within migration events (right) by season each year within the Associated Habitat Reach from 2017-2020.

- Based on preliminary results from February 2021, time of day was the most influential variable to predict stopover initiation (Table 1, Figure 2). All AHR stopovers occurred in the time of day from late afternoon to end of daylight. The earliest time of day an AHR stopover was initiated was at 14:48 on October 30th, 2019, and the latest occurred at 19:51 on March 19th, 2018.

Table 1. Whooping crane stopover decision model selection in the Associated Habitat Reach.

Model Rank	Variables	AICc	ΔAICc	weight
1	Time of Day * MUOCW	31.3	0	0.199
3	Time of Day	31.8	0.5	0.157
2	Time of Day * MUOCW + Flow	33.5	2.2	0.066
4	Time of Day + Flow	33.9	2.6	0.054
5	MUOCW	56.8	25.5	0
6	Flow	59.3	28	0

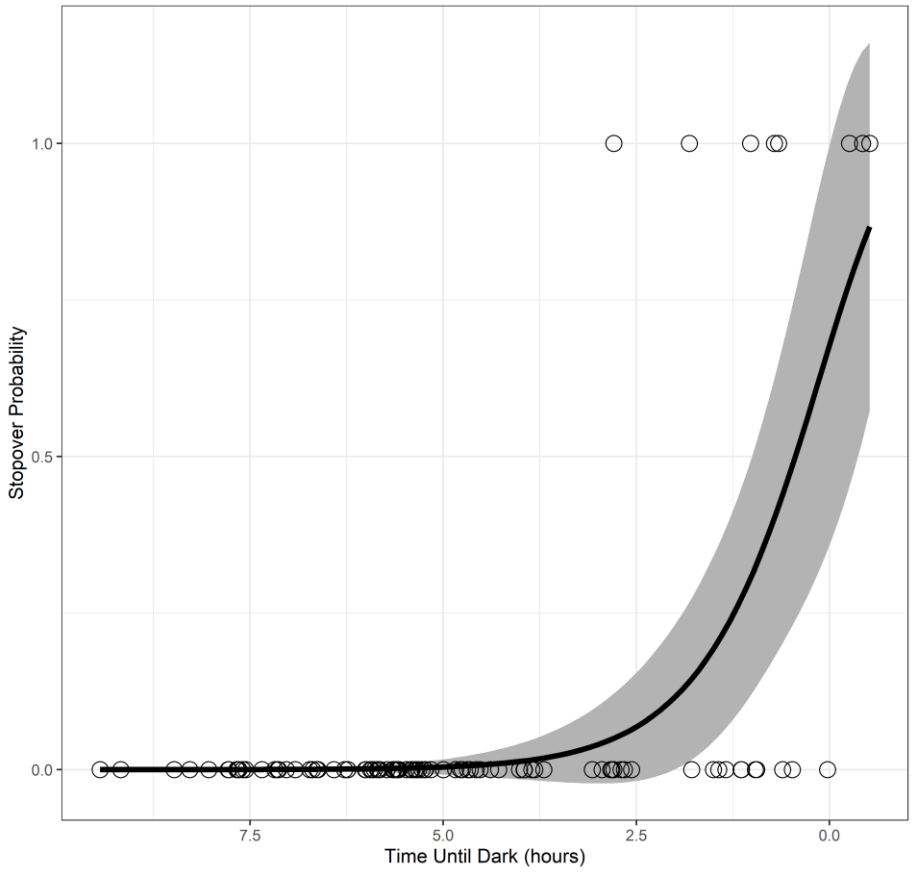

Figure 2. Predicted probability of an Associated Habitat Reach stopover in response to time until dark (sunset plus 30 minutes) of cellular telemetry marked whooping cranes from fall 2017 – spring 2020. Open circles represent whooping crane stopovers (y=1) and flyovers (y=0).