


[EXTERNAL] FW: 1004025 progress report due, P18AC00951

Joleen Pantier <JPantier@uwyo.edu>

Thu 3/23/2023 8:44 AM

To: Geremia, Chris J <Chris\_Geremia@nps.gov>

Cc: Vanessa Simoneau <vsimonea@uwyo.edu>

 1 attachments (764 KB)

BisonStructure\_Final\_Performance\_Report\_March2023.docx;

**This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.**

Good morning Chris,

Attached is the final performance report for P18AC00951, UW project 1004025. I have also uploaded it to Grant Solutions.

**Joleen Pantier**

Post-Award Specialist I

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**From:** Vanessa Simoneau <vsimonea@uwyo.edu>

**Sent:** Wednesday, March 22, 2023 11:17 AM

**To:** Joleen Pantier <JPantier@uwyo.edu>

**Subject:** Re: 1004025 progress report due

Hi Joleen,

The final report for 1004025 is attached here. This report will need to be submitted to our collaborator Chris Geremia ([chris\\_geremia@nps.gov](mailto:chris_geremia@nps.gov)), as Rick Wallen has retired. Please let me know if you need any additional information from us. Thank you!

Best,

**Vanessa Simoneau**

Pronouns: she|her|hers

Grants Manager

Wyoming Cooperative Fish & Wildlife Research Unit

[University of Wyoming](#)

Direct: 307-766-5495

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**From:** Joleen Pantier <[JPantier@uwyo.edu](mailto:JPantier@uwyo.edu)>

**Sent:** Tuesday, December 20, 2022 3:07 PM

**To:** Vanessa Simoneau <[vsimonea@uwyo.edu](mailto:vsimonea@uwyo.edu)>; Matthew Kauffman <[mkauffm1@uwyo.edu](mailto:mkauffm1@uwyo.edu)>

**Subject:** 1004025 progress report due

Good afternoon,

For 1004025, a progress report through 9/30/2022 is due on Grant Solutions by 12/29/2022. If you can send me the report, I'll get it uploaded for you.

Thank you!

**Joleen Pantier**

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20 March 2023

Final Federal Performance Report - FAIN: P18AC00951

## IDENTIFYING STRUCTURE OF THE YELLOWSTONE BISON POPULATION

The overall goals of this project were twofold. First, we aimed to determine the number of breeding herds in the Yellowstone bison population and characterize their genetic makeup. Second, we aimed to evaluate whether management removals that occur when bison migrate out of the park differentially affect breeding herd units.

Specific goals related to the statement of work, along with accomplishments after each, are listed below. In summary, all goals have been met or significant progress on the work has been achieved. In the cases where the goals were not fully met, Dr. Merkle in consultation with Dr. Geremia have agreed upon expectations and next steps.

### 1. Complete a network analysis of the spatial distribution of radio-collared bison

Accomplishments – Dr. Merkle in collaboration with Dr. Geremia have conducted the analyses to create networks of bison. All of that work has been documented in repeatable code and figures. An example of those networks is copied in Figure 1.

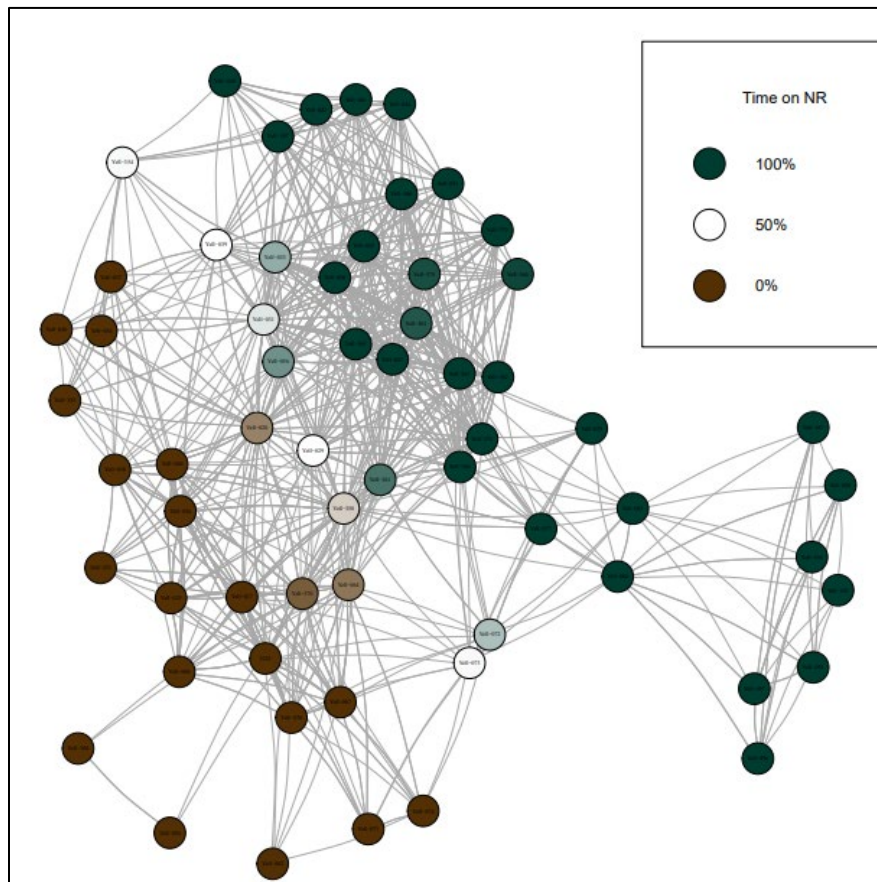


Figure 1. Social network of all bison collared from 2006 to 2020. Circles represent each collared animal (colored by the amount of time spent on the northern range) and lines represent whether a pair of individual ever spent any time together (i.e., were less than 100m from each other). The network demonstrates that there is some separation between animals that mainly live on the northern range from animals that mainly live in the interior. However, the network also shows that around 11 collared individuals spend significant amount of time on both the northern range and the interior and that those individuals interacted with many other individuals in those ranges. In other words, those individuals acted as network hubs, connecting bison from the northern range to bison in the interior.

## 2. Determine the connectedness of breeding groups between years

Accomplishments – Dr. Merkle has analyzed the bison networks and calculated the emergent properties of the networks to determine the connectedness of the northern and central bison herds. These analyses have been conducted for the breeding season, the management removal season, as well as over the entire year across 10 years where sufficient GPS data were collected by NPS. An example of the results of this analysis are depicted in Figure 2.

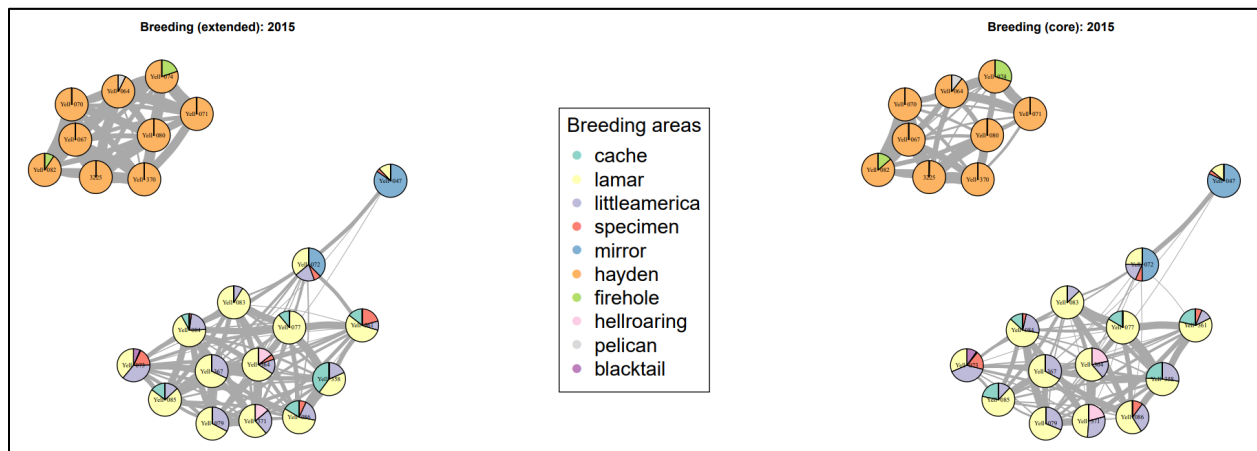


Figure 2. Social network of bison collared during the core and extended breeding seasons of 2015. Circles represent each collared animal (colored by the amount of time spent in different areas of Yellowstone) and lines represent whether a pair of individual ever spent any time together (i.e., were less than 100m from each other) and widths of the line represents the number of days spent together. The networks demonstrate that during the breeding season, there was clear separation of animals on the northern range and the interior. However, within those areas, and particularly on the northern range, there was significant mixing of animals across different areas. This analysis also suggests that the mixing of individuals from Figure 1 generally occurs outside of the breeding season and once breeding season starts, animals tend to stay either on the northern range or in the interior.

## 3. Describe the genetic composition of breeding groups using mitochondrial markers

Accomplishments – The mitochondrial analysis is the responsibility of NPS, and those results only recently were secured. Dr. Merkle has developed a workflow and code to calculate social networks and resulting social metrics for each individual that has genetic samples. This analysis has not been fully completed yet because there were some individuals with genetics data that had older collar data that has not been organized. Dr. Merkle and Dr. Geremia agreed that we would wait to complete this objective until the older collar data were organized and cleaned up. Nonetheless, Figure 3 illustrates the type of information that we have for each individual in each year, which can be used to assess the connection between sociality and genetic composition.

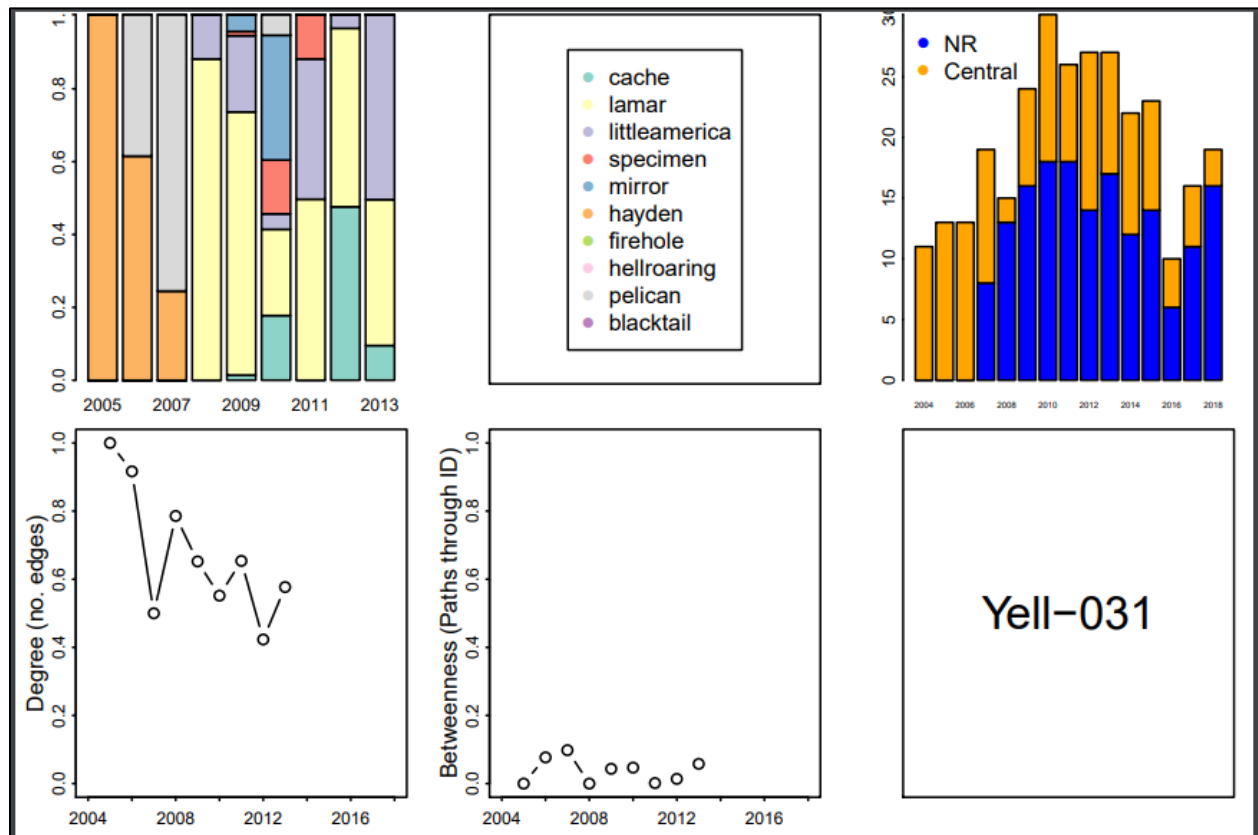
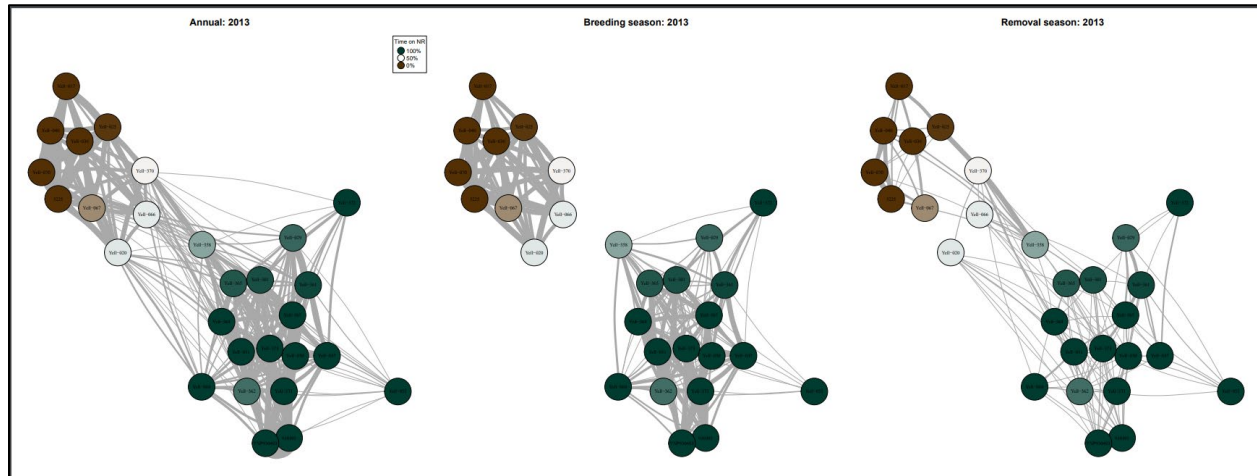


Figure 3. Individual social and spatial metrics for bison Yell-031 during the period it was collared from 2005 to 2013. The upper left panel (and upper middle panel) represents the amount of time the animal spent in different areas of the park during the breeding season in each year. Note that this individual spent its first three years in the interior of the park and then switched to the northern range after the breeding season of 2007. The upper right panel depicts the amount of time all collared animals spent on the northern range versus the interior. The bottom left and center panel depicts two metrics that explain how social this animal was relative to other individuals that were collared during each year. The bottom left panel depicts that this animal interacted with many of the collared animals, but this number decreased as the years passed. The middle bottom panel denotes that while this animal was connected with many individuals, it was not a 'central' animal within the networks. In other words, this animal did not clearly connect multiple groups of individuals within the park.

4. Evaluate the risk of management removal to each breeding group.

Accomplishments – Dr. Merkle has developed social networks during the removal season (see Figure 4). However, Dr. Geremia and Dr. Merkle discussed this and agreed that this analysis must wait until all the genetics analyses have been completed.



*Figure 4. Social network of bison collared during the entire year, the breeding season, and during the removal season of 2013. Circles represent each collared animal (colored by the amount of time spent on the northern range versus the interior of the park) and lines represent whether a pair of individual ever spent any time together (i.e., were less than 100m from each other) and widths of the line represents the number of days spent together. These networks denote that much of the connections of individuals across the northern range and the interior of the park occur during the removal season, not during the breeding season.*