

## **Exercise 4 Report:** *National Bison Range Bighorn Sheep Dominance*

### ***Motivation:***

The wins and losses of 28 bighorn sheep in the National Bison Range were recorded in 1984. This data shows sheep age and observations of sheep dominance in the group. Using the data it can be determined how sheep dominance works in the observed population.

### ***Data Augmentation:***

The provided dataset includes the age of each sheep and the dominance between sheep. For each sheep the data gives a weight equal to how many times it was seen dominating another sheep. Another value equal to the number of different sheep a sheep was observed dominating was calculated and added to the information for each sheep.

### ***Tasks:***

Can we view how individual sheep dominate each other? Does sheep dominance correspond to the age of the sheep?

### ***Expressiveness of Design:***

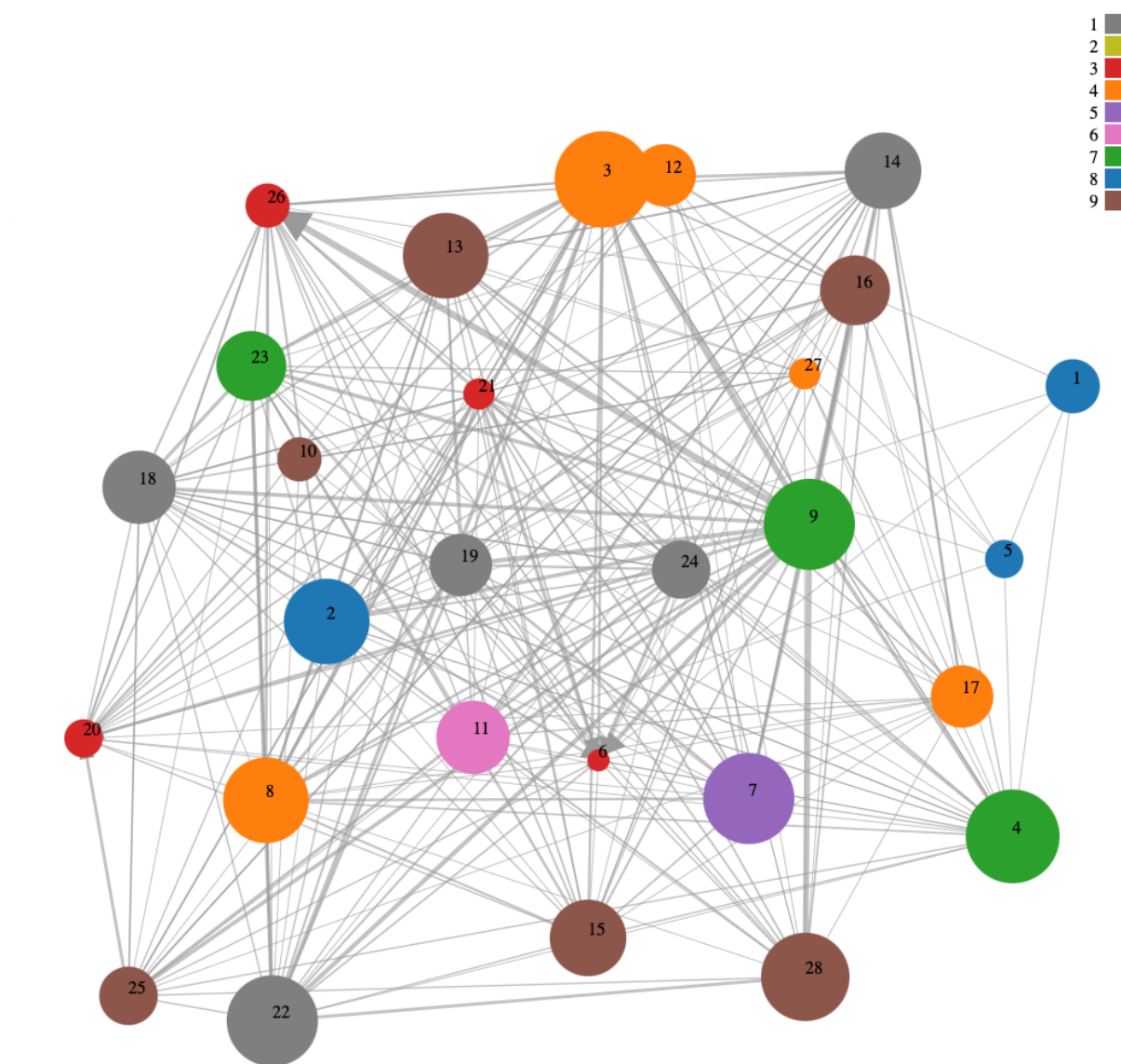
The sheep dominance is expressed using a force directed graph which links sheep based on dominant and dominated sheep in observations. The links are directed using arrows pointed toward the dominated sheep. The links are scaled based on the number of observations between the linked pairs of sheep. A sheep that was seen dominating the sheep multiple times will have a thicker link between the two nodes for identifying domination pairs.

The sheep themselves are represented by nodes labeled by a given id. The color hue of the sheep nodes is used to denote the age of the sheep to identify sheep of the same age. The radius of the nodes signifies a sheep with more links where it is the dominating sheep to identify sheep that are more dominant. The image below shows a representation of the visual.

### ***Effectiveness of the Solution:***

The highly interconnected nature of the data makes the network visualization cluttered. The use of thickness scaled lines allows for the viewer to more easily determine pairs of sheep which have been observed to be in contention multiple times to more easily find if specific sheep are in dominance struggles. By calculating the number of dominant observations for each sheep it was possible to use the area channel to identify individual sheep dominance. Scaling the size of the sheep nodes also allows for a viewer to effectively determine which sheep are the most dominant in the population and which are more subservient.

The color hue identification also effectively lets a viewer see how the age of the sheep affects its dominance in the population. Combining the color hue identification channel with area magnitude channel a viewer can quickly make a determination of whether similarly aged sheep show more or less dominance.



***Interaction:***

Visual interaction is achieved by using the force directed graph type that allows a user to drag nodes to reshape the visual as desired. A user can move nodes to see its specific interactions or group nodes by size and color as desired. The visual also highlights the paths to and from a node when it is moused over by increasing the weighting of the link thickness. This allows a viewer to more easily see the links for a desired sheep.

***Conclusions:***

The visualization gives an effective way to explore the dominance trends observed in a population of bighorn sheep. A viewer can quickly see which sheep are most dominant by the size of the node and which sheep it has interacted with by selecting the node and highlighting the

links connected to the node. Categorical coloring of the nodes allows for viewing how age of a sheep affects its dominance within the group.

From the visual There does not appear to be a definitive trend between sheep age and how dominant it is in the group. It can be seen that the 3 year old sheep are the least dominant but there are dominant and less dominant sheep throughout the different ages. We can also see that some sheep appear to get into dominant competition often while others don't compete often by the different number of links attached to the nodes. However, if a sheep does compete for dominance it seems to compete against many different sheep in the population. The least dominant sheep are dominated by most of the members of the population.