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| WRL reference | M03 D01 |
| Module | M03 Animal Behaviour |
| Data set | D01 Bull elephant dominance relationships after contraception |

Data collection methods:

The elephant population at Pongola Game Reserve in South Africa consists of 8 adult bulls, the A&B family herd containing 57 individuals and the orphan herd containing 14 individuals. Only one bull (Ingani, born 1969) can be described as fully adult (i.e. over 40 years old). The rest of the bulls are similar in age and are best described as young adults (Shayisa, born 1991; Kohlewe, born 1995/1996, Lucky born 1996; Asiphephe, born 1997; Khumbula, born 1997; Nitini, born 1997; Mgangane, born 1999). In 2008, the Disney Corporation provided funding for vasectomies of the bull elephants in an attempt to cap the population. Only seven bulls were actually vasectomised because the oldest male Ingani was so large that the risks associated with surgery for this individual was too high. The social interactions of these bulls were monitored over time to determine whether normal patterns of social dominance persist in this population despite the vasectomies.

Data were collected from February 2010 until August 2012. Elephant behaviour was recorded using 15-minute focal animal samples with continuous recording. This means that one individual was followed for a 15-minute period and everything that the individual did during that time was recorded. For all dominance interactions (aggression, trunk over back, tusk interlocking, and submissive displays) the individuals involved and the winner and loser of the contest were identified. Once the 15 minutes was over, a different individual was followed and this process was repeated to ensure roughly equal amounts of data collected on each individual.



Figure 1. Photograph of interlocking tusk behaviour by bull elephants. The bulls lock their tusks and push against each other. The male that is able to stand his ground rather than be pushed backwards is the winner of the interaction





Analysis methods:

Elephant Identification:

In order to investigate social interactions between the bull elephants, it is first necessary to learn how to identify each individual bull. This can be done by learning to recognise key characteristics about their ears and tusks.

NOW OPEN THE FILE "M03 D01 ELEPHANT IDENTIFICATION EXERCISE.docx" AND OPEN EACH OF THE PDF FILES IN THE FOLDER "M03 D01 BULL ELEPHANT ID KITS"

There are eight different bull elephant ID kits give details of the bull (name, mother, age, height etc) and schematic drawings of the face showing notable markings on the tusks and ears. Use these ID kits to identify each of the bulls from the photographs presented in the file "M03 D01 ELEPHANT IDENTIFICATION EXERCISE".

Dominance Hierarchies:

Dominance hierarchies are calculated using a dyadic dominance interaction matrix showing all the possible dyads (pairs of individuals) and the number of times that each member of a dyad has won or lost a dominance interaction against the other member of the dyad. The first step is to simply create a dominance matrix listing the dyad members (i.e. the bull elephants) in alphabetical order (see Figure 2). The matrix should be re-arranged by shuffling the order of dyads based on which individuals won the most dominance interactions across dyads. This means that you should end up with all the 0 values above the diagonal grey line. For example, if we look at the interactions involving Ingani we see that he was the winner of all his dominance interactions. Ingani should therefore move to the far left of the table as he is the highest ranking bull (see Figure 3).

| | | Winner | | | | | | | |
|-------|-----------|-----------|--------|----------|---------|-------|----------|-------|---------|
| | | Asiphephe | Ingani | Khumbula | Kohlewe | Lucky | Mgangane | Ntini | Shayisa |
| Loser | Asiphephe | | 1 | 6 | 25 | 1 | 0 | 0 | 9 |
| | Ingani | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| | Khumbula | 31 | 1 | | 55 | 10 | 0 | 0 | 25 |
| | Kohlewe | 7 | 2 | 13 | | 1 | 0 | 0 | 11 |
| | Lucky | 0 | 1 | 3 | 3 | | 0 | 1 | 8 |
| | Mgangane | 6 | 1 | 4 | 6 | 4 | | 21 | 1 |
| | Ntini | 15 | 2 | 24 | 1 | 13 | 6 | | 6 |
| | Shayisa | 0 | 12 | 1 | 0 | 0 | 0 | 0 | |

Figure 2. Dominance interaction matrix with dyads arranged in alphabetical order





| | Winner | | | | | | | |
|-------|-----------|-----------|----------|---------|-------|----------|-------|---------|
| | Ingani | Asiphephe | Khumbula | Kohlewe | Lucky | Mgangane | Ntini | Shayisa |
| | Ingani | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Asiphephe | 1 | 6 | 25 | 1 | 0 | 0 | 9 |
| | Khumbula | 1 | 31 | 55 | 10 | 0 | 0 | 25 |
| Loser | Kohlewe | 2 | 7 | 13 | 1 | 0 | 0 | 11 |
| | Lucky | 1 | 0 | 3 | 3 | 0 | 1 | 8 |
| | Mgangane | 1 | 6 | 4 | 6 | 4 | 21 | 1 |
| | Ntini | 2 | 15 | 24 | 1 | 13 | 6 | 6 |
| | Shayisa | 12 | 0 | 1 | 0 | 0 | 0 | 0 |

Figure 3. Dominance interaction matrix with Ingani moved to highest ranking position

In some cases, however, there will not be a 0 value for a dyad, meaning that in some cases one member of the dyad won the interaction, but in other cases the other member of the dyad won (e.g. the Kohlewe and Khumbula dyad). In these cases you need to ensure that the higher of the two numbers for the dyad is BELOW the diagonal grey line.

NOW OPEN THE FILE “M03 D01 DOMINANCE RAW DATA.xls” (found in the 4.’ Data for tasks’ folder)

The file contains the dominance interaction matrix for the Pongola bulls based on alphabetical order of the bulls and a blank matrix below. You need to rearrange the order of the bulls using the method described above in order to calculate the dominance hierarchy of the bulls.

IF YOU OPEN THE FILE “M03 D01 DOMINANCE COMPLETED.xls” YOU CAN CHECK THAT YOUR CALCULATIONS ARE ALL CORRECT

Now you need to find a suitable way of displaying your data so you can see if there is a relationship between the dominance rank of the bull elephants and their age. When you are looking for relationships between two variables, the best type of figure (or graph) to use is a scatter plot. If dominance rank is correlated with age then you would expect to the points on the scatter plot to be arranged in a diagonal line sloping downwards from left to right (i.e. the bull with the highest rank score of 1 should also be the oldest, the bull with the second highest rank score of 2 should be the second oldest and so on).

IF YOU ARE STILL UNCERTAIN HOW TO COMPLETE THE MATRIX - GO TO THE HINT FILE IN THIS FOLDER - IT GIVES YOU A DETAILED ‘WALK-THROUGH’ ON HOW TO DO IT!

NOW OPEN THE FILE “M03 D01 AGE AND DOMINANCE RAW DATA.xls”





To do create the scatter plot, highlight all the values in the columns Age and Rank. If you now click on “Insert” and then “Scatter”, Excel will create a graph of the highlighted data. You will now want to make the figure more presentable by adding titles to both the x-axis and the y-axis (remember to include units on both of these), and a title to the whole graph (beginning with “Figure 1: XXXXXX”). It is also advisable to delete the legend and gridlines to make the data clearer.

IF YOU OPEN THE FILE “M03 D01 AGE AND DOMINANCE COMPLETED.xls” YOU WILL SEE WHAT THE FINISHED GRAPH SHOULD LOOK LIKE

