

Name: _____

Investigating human-induced unnatural selection in African elephants (*Loxodonta africana*)

Watch the HHMI BioInteractive video “Selection for Tuskless Elephants”

(<https://www.hhmi.org/biointeractive/selection-tuskless-elephants>)



Summary

Working in Gorongosa National Park, Mozambique, Dr. Joyce Poole and colleagues made a striking observation: many female elephants lack tusks.

SCIENTISTS AT WORK:(Duration: 06 min 39 sec)

 Play Short Film

After you watch the video, work with your partner to answer the following:

1. Describe how the population of elephants in the video changed over time.
2. What phenotypic changes did the researcher notice in the population over time.
3. What has driven the changes in the population of elephants?
4. Given the changes in the population, do you think tusklessness is a heritable trait? Explain your reasoning.

5. The table to the right summarizes a recent census of the Gorongosa elephants by Dr. Joyce Poole.

Table 1. Tusklessness in the registered elephants in Gorongosa National park, Mozambique.

Sex	N	Tuskless	% Tuskless
Male	54	0	0%
Female	81	41	51%

a. Is tusklessness more common in male or female elephants?

b. Compare and contrast the advantages and disadvantages of having tusks in the absence and presence of poachers.

	Advantages of having tusks	Disadvantages to having tusks
In the absence of poachers		
In the presence of poachers		

c. Are the advantages/disadvantages you identified in part b. the same or asymmetric in males and females? Explain.

d. Provide a hypothesis to explain the pattern observed in Table 1.

6. If you were to go back to this population in 100 years, predict how frequent tusklessness would be if...
 a. there was no poaching...

b. there was another extreme poaching event...

Justify your reasoning:

How have other African elephant populations changed in response to poaching?

As Joyce Poole mentioned, there are many other populations of elephants on the African continent and they may have also experienced similar selective pressures due to poaching as the populations in Gorongosa. To further investigate these effects, we will examine data comparing historical and contemporary populations of elephants along the Kenya-Tanzania border. The populations in Kenya and Tanzania are among the largest on the African continent, according to a recent census by Chase *et al.* (2016). Similar to the Gorogosa populations, these populations have experienced poaching and have suffered recent population declines (Chase *et al.* 2016).



Figure 1. Photo from tusk harvest in the 1880s (Robert H Milligan, New York Public Library)

MEASUREMENTS:		WEIGHTS:	
Total body length		Hind leg	
Crown-rump length		Stomach, full/empty	/
Occiput - tail		Stomach fill	/
Occiput - base of ear → 7'11"		Intestine, full/empty	/
Tail		Intestine fill	
S. height (st.) → 7'4 1/2"		Kidneys, + fat	
S. height (C.)		Kidneys, - fat	
Girth x 1/2		Temporal gland	
Forefoot diam R/L	/	Brain	
Hindfoot diam R/L	/	Pituitary	
Forefoot circum.	/	Adrenals, R/L	/
Hindfoot circum.	/	Thyroid	
Toenails, fore R/L	/	Heart	
Toenails, hind R/L	/	Lungs & trachea	
Tusks, lip - tip	/	Liver	
Tusks, total length	/	Spleen	
Tusks circum.		Tusks R/L	8 1/2 5

Figure 2. Example of historical records of elephant morphology used by Chiyo *et al.* (2015)

Chiyo *et al.* (2015) investigated changes in populations of *Loxodonta africana* located along the Kenya-Tanzania border between the 1960s and the 2000s. Rather than observing tusklessness like Dr. Poole, Chiyo *et al.* (2015) examined evidence of subtler changes in tusk morphology over time due to poaching. They used Historical records to collect height (estimated to the shoulder), tusk length, and tusk circumference from approximately 600 elephants that were culled in Tsavo East National Park (Kenya) and Mkomazi National Park (Tanzania) between 1966 and 1968. Figure 2 is an example of the historical records used in the study (for more information see: <http://ufdc.ufl.edu/AA00013409/00007>). Contemporary data were collected from live animals that were translocated from southern Kenya to Tsavo East National Park (2005), Masai Mara National Reserve (2011), and Meru National Park (2013).

7. Given what you have learned about the long-term impacts of poaching on elephant populations, make a prediction about changes in tusk size from the 1960s population to the 2010s population Chiyo *et al.* (2015) surveyed.

I expect that the elephants in the 1960s had... (circle one) **larger** **smaller**
 ... tusks compared to elephants measured in the 2000s, **because:**

8. Together we are going to analyze data Chiyo *et al.* (2015) used in their study (available from Dryad Data Repository).

- The datafile has tusk length (cm), tusk circumference (cm), shoulder height (cm) for elephants from two time points, 1966-1968 and 2005-2013.
- Open the datafile 'Elephant Morphometrics and Tusk Size-ExcelActivity.xlsx' in Excel.
- Working with your partner, you each choose either the 1966-1968 or the 2005-2013 data to analyze. They are in two separate tabs, make sure you are using the correct data set.
- Record the data set you are working with: _____

9. Calculate the average tusk length, tusk circumference, and shoulder height for your data set.

Year	Sex	Average tusk length (cm)	Average tusk width (cm)	Average height (cm)
1966-1968	Male			
1966-1968	Female			
2005-2013	Male			
2005-2013	Female			

Note: This is easiest done by sorting your data by Sex and using the formula =AVERAGE(C2:C12) where C2:C12 are the values you are using to calculate the average. Alternatively, you can use a Pivot table to summarize the data. Review the HHMI Excel tutorials if you need help.

10. How do your values in Question 9 compare with your partner's values? Note any similarities or differences.

11. Working together, create a single figure that illustrates the differences between your data sets.

Insert your figure here:

Figure 1: Insert figure title and caption here

12. Answer the following about the figure you created:

- a. What plot type did you create?

- b. Why did you choose that particular plot type?

- c. What variables did you compare?

- d. What did you learn?

13. Compare your results with another group.

- a. What did you learn from the other group?

- b. What would you like to investigate further?

14. Recall from the video that the researchers focused on the importance of tusks. Using your analyses, answer the following questions.

- a. In general, which population (1966-1968 or 2005-2013) had longer tusks on average?

- b. Did males or females typically grow longer tusks? Are these results expected? Why or why not?

- c. Does the difference in average body size strongly correlate with differences in tusk length over time? What does this suggest about selective pressure on tusk size?

15. Are your results from the Chiyo *et al.* (2015) data expected when taking into consideration the observations from other populations of elephants (like the Gorongosa population) and what you predicted earlier in the activity? Why or why not?

16. Consider the evolutionary effects of poaching on elephants.
- a. Do the changes in tusk length over time in males and females suggest that selection acts the same or differently on males and females? Explain.

 - b. When considering sexual selection, do you think males are likely the competitive sex (typically competing with other males to gain access to more mates) or the choosy sex (where they have access to ample mates and only chose specific females to mate with)? Justify your answer.
15. Conclusions:
- a. What are the short and long-term impacts of these changes on elephant populations?

 - b. While poaching may affect phenotypic changes in tusk length, is the population decline of concern? Why or why not?

References:

- Chase, M. J., S. Schlossberg, C. R. Griffin, P. J. C. Bouché, S. W. Djene, P. W. Elkan, S. Ferriera, F. Grossman, E. M. Kohi, K. Landen, P. Omondi, A. Peltier, S. A. F. Selier, and R. Sutcliffe. 2016. Continent-wide survey reveals massive decline in Africa savannah elephants. *PeerJ*, 4:e2354
- Chiyo, P. I., V. Obanda, and D. K. Korir. 2015. Illegal tusk harvest and the decline of tusk size in the African elephant. *Ecology and Evolution*, 5 (22): 5216-5229.
- Chiyo PI, Obanda V, Korir DK. 2015. Data from: Illegal tusk harvest and the decline of tusk size in the African elephant. Dryad Digital Repository. <https://doi.org/10.5061/dryad.h6t7j>