

Analyzing Data on Tuskless Elephants

OVERVIEW

This data-driven activity accompanies the BioInteractive Scientists at Work video [Selection for Tuskless Elephants](#). By watching segments of this video, students will follow the analyses and discoveries of Dr. Joyce Poole, a scientist who has studied elephants for many years. Students will then analyze data to investigate the impact of human activity, namely poaching, on elephant populations.

KEY CONCEPTS

- Human activities influence the abundance and distribution of living organisms, as well the selective pressures on these organisms.
- Selection can shift the distribution of traits in a population. This is because organisms with an inherited trait that is advantageous in a particular environment tend to increase in proportion relative to organisms lacking this trait.
- Thorough scientific research requires the analysis of relevant variables and the careful, thoughtful interpretation of results.
- Proposing a claim to answer a scientific research question requires the systematic analysis of relevant data.

STUDENT LEARNING TARGETS

- Analyze quantitative data in order to make predictions based on evidence.
- Use evidence-based predictions to explain how a population changes over time due to human impacts.
- Explain how the selective pressures on a population may impact the frequencies of phenotypes.
- Propose a claim supported by scientific evidence to answer a research question.
- Determine whether scientific results confirm or contradict a hypothesis.
- Provide evidence-based reasoning that uses available data to support a scientific claim.

CURRICULUM CONNECTIONS

Standards	Curriculum Connection
NGSS (2013)	HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5
AP Bio (2015)	2.D.1, 4.A.5, SP2, SP3, SP5
IB Bio (2016)	4.1, C.3
AP Env Sci (2012)	II.A, II.C, VII.C
IB Env Systems and Societies (2017)	2.1, 2.2, 3.2, 3.4
Common Core (2010)	ELA.RST.9-12.7, WHST.9-12.1; Math.N-Q.A.1, N-Q.A.3, S-IC.3, MP2, MP3
Vision and Change (2009)	CC1, CC5, DP1, DP2

KEY TERMS

adaptation, claim, evidence, frequency, phenotype, poaching, population, reasoning, selection, selective pressure, variation

TIME REQUIREMENTS

- One to two 50-min classroom periods or one 90-min block period is recommended. Time requirements may differ depending on computer/internet access.
- The Extension Activity (“Claim-Evidence-Reasoning” chart) may be assigned as homework.

SUGGESTED AUDIENCE

- High School: Biology (all levels), Environmental Science (all levels)
- College: Introductory Biology or Ecology

PRIOR KNOWLEDGE

Students should be:

- familiar with the concepts of adaptation, populations, ecosystems, and selection
- comfortable using data tables to organize and analyze information
- able to use calculators for simple calculations, including percentages (optional)

MATERIALS

- printed "Part 1" and "Part 2" activity sheets
- [Selection for Tuskless Elephants](#) video
- calculator (optional)

TEACHING TIPS

- For each video segment, students should make their predictions individually. Afterward, have students form pairs or groups to share their predictions and discuss their ideas before continuing the activity.
- It is recommended that students watch the video segments in class and not as assigned homework. This will ensure that students are not watching more of the video than they should at each interval.
- It is recommended to print and distribute the "Part 1" and "Part 2" activity sheets separately, so that students do not read ahead.

ANSWER KEY: PART I: INTRODUCTION

A survey of African savanna elephants revealed that populations declined by 30% between 2007 and 2014. As of 2014, about 350,000 savanna elephants were living in Africa. Their current rate of decline is 8% per year, primarily due to illegal killing called poaching.

Why are so many elephants being illegally killed? And how is this poaching affecting elephant populations? You will explore these two questions by examining data from several studies and watching a video about elephants living in Gorongosa National Park in Mozambique.

Pre-Video Activity: Testing Your Prediction

Table 1 shows the numbers of elephants that were illegally killed in a region of Zambia from 2007 to 2013. The elephants were categorized based on descriptions of their carcasses; these descriptions allow researchers to infer why the elephants were killed.

The first four rows show categories of elephants that originally had tusks. The fifth and sixth rows show categories of elephants that *naturally* do not have tusks, or are tuskless. Individual rows show whether meat and/or tusks were taken from the elephants after they were killed; researchers can infer that these elephants were killed for their meat and/or tusks.

Examine the data and then answer the questions after the table.

Table 1. Elephants killed illegally in North Luangwa Valley, eastern Zambia, 2007–2013 (Nyirenda *et al.*, 2015).

Elephant type	Description of carcass	Number killed each year							Totals
		2007	2008	2009	2010	2011	2012	2013	
Tusks naturally present	• Meat and tusks taken	3	2	2	4	6	6	4	27
	• Meat and tusks not taken	0	0	0	2	1	0	5	8
	• Meat intact but tusks taken	1	4	7	4	7	27	25	75
	• Meat taken but tusks intact	0	0	2	2	3	0	8	15
Tusks naturally absent (tuskless)	• Meat taken	0	0	1	0	2	0	1	4
	• Meat intact	0	0	0	0	0	0	0	0
	Total number of elephants illegally killed	4	6	12	12	19	33	43	129

- How did the total number of elephants that were illegally killed change from 2007 to 2013?
It increased from 4 to 43.
- In general, did most of the elephants that were illegally killed have tusks, or were they naturally tuskless?
Most had tusks.
- Calculate the total number of elephants that appear to have been illegally killed between 2007 and 2013 for:
 - only their meat **19**
 - only their tusks **75**
 - both their meat and tusks **27**
- Calculate the percentages of the illegally killed elephants between 2007 and 2013 represented by each group of elephants in Question 3. Show your work.
 - percentage of elephants killed *only* for their meat
 $19/129 = 14.7\%$
 - percentage of elephants killed *only* for their tusks
 $75/129 = 58.1\%$
 - percentage of elephants killed for *both* their tusks and meat
 $27/129 = 20.9\%$
- Use the evidence above to make a claim about the **main reason elephants were illegally killed** in this region.
The highest percentage of killed elephants were killed only for their tusks. So the main reason that these elephants were illegally killed was probably so that people could take their tusks (for ivory).
- Suggest some ways to reduce the number of elephants that are illegally killed each year.
Answers may vary.

Video Activity

- Watch the [Selection for Tuskless Elephants](#) video until time 1:46 and answer the following questions.
 - What did Dr. Joyce Poole observe about the elephant population in Gorongosa National Park in Mozambique?
Some of the elephants in Gorongosa National Park were tuskless.
 - What happened in Mozambique from 1977 to 1992?
There was a civil war.
 - How were the elephants in Gorongosa National Park affected by this event?
Poaching increased because soldiers hunted elephants for their tusks (ivory).

8. Resume watching the video until time 4:03 and answer the following questions:
- Select all the descriptions that apply to the trait of “tusklessness.”
 - occurs naturally in elephant populations
 - does not occur in nature
 - is common among most elephants
 - is more prevalent in males than females
 - is more prevalent in females than males
 - is inherited
 - Dr. Poole says that there is strong selective pressure for male elephants to have tusks. Explain what that means.

Males need tusks to fight other males for females (intrasexual competition). Without tusks, males are less likely to survive these fights and reproduce. So there is stronger selective pressure for males to have tusks than for females to have tusks.

9. Resume watching the video until time 4:29, right after you reach the graph below.

- Describe what the bar on the left is showing.

The bar on the left is showing the percentage of tuskless females of all ages in populations with less poaching.



- Describe what the bar on the right is showing.

The bar on the right is showing the percentage of tuskless females that are at least 20 years of age in Gorongosa National Park, a population with heavy poaching.

- Explain why the bar on the right is much higher than the bar on the left.

The population shown on the right suffered a higher level of poaching. Poachers killed many of the elephants with tusks and thus selected for tuskless elephants.

10. The civil war in Mozambique ended in 1992. Based on the data above, predict whether the percentage of tuskless females born after the civil war was:
- more or less than the percentage of tuskless females that were civil war survivors (bar on the right)

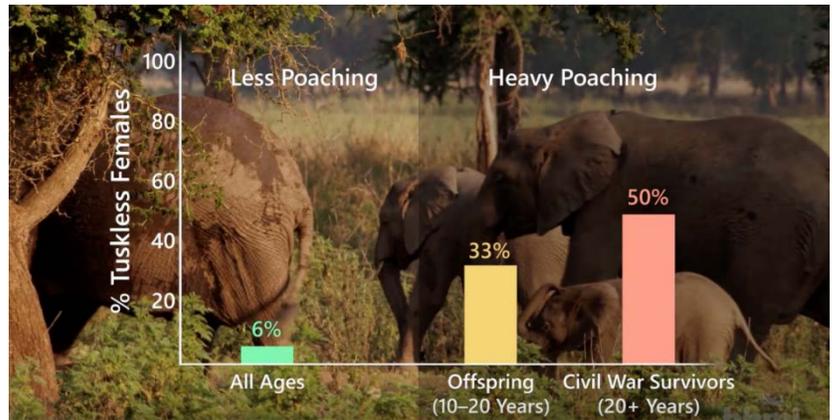
Students may predict that this percentage decreased, increased, or stayed the same.
 - more or less than the percentage of tuskless females in populations with less poaching (bar on the left)

Students may predict that this percentage decreased, increased, or stayed the same.
11. Explain your reasoning for the answers above:
- Student responses will vary according to their predictions above. Strong responses should cite appropriate evidence that supports their claims and is based on the data provided.*
 - Student responses will vary according to their predictions above. Strong responses should cite appropriate evidence that supports their claims and is based on the data provided.*

ANSWER KEY: PART II: CONTINUED ANALYSIS

12. Continue watching the video until time 4:56, soon after you reach the graph below.

- a. You made a prediction in Question 10 about tuskless female elephants born after the civil war ended. These elephants would be 10–20 years of age when Dr. Poole collected her data. Does the data in the graph above support your prediction? Explain why or why not.



Student responses will vary according to their previous predictions. Strong responses

should cite appropriate evidence that supports their claims and is based on the data provided.

- b. Why might tusklessness be less common in 10- to 20-year-old elephants than in elephants over 20 years of age?

Student responses should include the concept of the selective pressure (poaching) being reduced after the civil war. Therefore, tusked females were not being selectively removed from the population as they were during the war.

Finish watching the video and answer the following questions.

13. Dr. Poole noticed a high proportion of tuskless female elephants in Gorongosa. What was the selective pressure that increased the proportion of tuskless females?

Poaching was the selective pressure that reduced the proportion of tusked females, which increased the proportion of tuskless females. Tusklessness is an inherited trait. So the surviving tuskless females produced offspring that were more likely to be tuskless too.

14. No tuskless males have been found in Gorongosa. Why would there be a difference between male and female elephants when it comes to having tusks?

Student responses may be similar to those for Question 8b. They should include the idea that there is strong selection for males that have tusks through competition for mates.

Extension Activity

Examine the table below.

Table 2. Tusklessness in different elephant populations across Africa (Steenkamp *et al.*, 2007). In populations experiencing controlled culling, humans legally removed a restricted number of elephants to prevent overpopulation. These elephants were usually chosen randomly. In populations experiencing poaching, humans illegally killed an unrestricted number of elephants. These elephants were usually killed for their tusks.

Level of human activity	Population	Adult females			Adult males	
		Total number	Number tuskless	Percent tuskless	Total number	Number tuskless
Minimal human activity	Kaudom	73	0	0%	38	0
	Moremi	29	1	3.4%	15	0
	Chobe	66	0	0%	20	0
	Amboseli	197	3	1.5%	20	0
Controlled culling	Etosha	39	1	2.6%	6	0
	Kruger	104	0	0%	24	0
High levels of poaching	South Kafue	86	2	2.3%	3	0
	North Kafue	91	0	0%	20	0
	Vwaza	19	3	15.8%	0	0
	South Luangwa	70	17	24.3%	0	0
	North Luangwa	86	23	26.7%	8	0

Complete the "Claim-Evidence-Reasoning" chart below. Cite evidence based on the data above or in the [Selection for Tuskless Elephants](#) video.

<p>Claim: In general, the prevalence of female tuskless elephants is highest in areas with heavy poaching.</p>
<p>Evidence: <i>Answers may vary but should include evidence from data provided. Students may point out that the data mostly support their claim, but there are some inconsistencies (for example, the data in Moremi, Etosha, South Kafue, and North Kafue).</i></p>
<p>Reasoning: <i>Answers may vary but should include rationale for how the evidence above supports the claim.</i></p>

Teacher Tip: You may ask your students to hypothesize why some data (for example, the data from Moremi, Etosha, South Kafue, and North Kafue) do not fit the pattern of other populations. This is a good opportunity to point out that real data is often messy and may be affected by other factors.

REFERENCES

Nyirenda, Vincent R., Peter A. Lindsey, Edward Phiri, Ian Stevenson, Chansa Chomba, Ngawo Namukonde, Willem J. Myburgh, and Brian K. Reilly. "Trends in illegal killing of African elephants (*Loxodonta africana*) in the Luangwa and Zambezi ecosystems of Zambia." *Environment and Natural Resources Research* 5, 2 (2015): 24–36. <http://dx.doi.org/10.5539/enrr.v5n2p24>.

Steenkamp, Gerhard, Sam M. Ferreira, and Marthán N. Bester. "Tusklessness and tusk fractures in free-ranging African savanna elephants (*Loxodonta africana*)." *Journal of the South African Veterinary Association* 78, 2 (2007): 75–80. <http://dx.doi.org/10.4102/jsava.v78i2.294>.

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