

Parentage and Geography

Name: _____

5. The Life of Lulu the Lioness: A Heroine's Story

Objective

Using genotypes from many individuals, determine maternity, paternity, and relatedness among a group of lions.

Background

In lion prides, there are often one or two males who join a pride in an area with several females and their cubs. When new males enter a pride, they displace the resident males and then may kill any existing cubs in order to mate with resident females and produce offspring of their own. Researchers have been studying lion prides to gain a better understanding of how their social hierarchy works and if alloparenting—the caring for young by family members other than the parents—is present in this species. It is, of course, difficult to determine true parentage for each cub due to the presence of so many possible males and females in a social group.



In this story, you will travel to Namibia and track lions, including our heroine, Lulu, and hypothesize how they travel by using sightings data. You will then attempt to determine the true mother and father of the cubs in question. By using genetics to establish maternity and paternity, we can now find the truth!

Procedure

In Namibia, field researchers have followed several lion prides that have been established for quite some time. Juvenile male lions often leave their pride as they approach maturity to look for other prides in which they can mate with females and produce cubs of their own. Females have been known to move but often remain in the same pride for many years with their female relatives. By using the map on page 48 and sightings data, you will track the origins and movements of particular lions and then will analyze their genotypes to ascertain how each is related to the others. You can then assemble a pedigree for the known individuals.

- 1) Using the sightings data, determine who moved from one area to another and fill this data in on the data sheet.
- 2) You should consult the map and draw arrows detailing where each individual moved. If any individual is no longer seen, you may draw a single line through their identification number. Be sure to draw the arrows in different colors and create a key that will enable you to easily distinguish one travel pattern from another. See the map for further directions.
- 3) Follow the instructions for the genetic analysis page 50. In the table marked Genotype Data, be sure to fill in the known maternal genotype and the known paternal genotype for each cub.

Hypothesis

After reading through the **sightings data and field notes**, answer the following:

Based on the sightings data, write who you think may be the father(s) of the cubs: _____

Based on the sightings data, write who you think may be the mother(s) of the cubs: _____

Once you write your hypotheses above, get your teacher's initials before continuing:



Sightings Data

Lion ID	Gender	Birth Year	Status	Origin	Residing Now?
628	F	1984	Alive	Rietfontein	Rietfontein
630	F	1984	Alive	Rietfontein	Rietfontein
664	F	1989	Alive	Rietfontein	Rietfontein
670	F	1989	Alive	Rietfontein	Rietfontein
687	F	1989	Alive	Rietfontein	Rietfontein

Lion ID	Gender	Birth Year	Status	Origin	Residing Now?
633	M	1983	Dead? (1992)	Unknown	N/A
631	M	1984	Alive	Goas	Rietfontein
695	M	1985	Alive	Unknown	Rietfontein
657	M	1989	Alive	Rietfontein	Unknown
668	M	1988	Alive	Rietfontein	S. African Reserve

Cubs born into Rietfontein pride:

Lion ID	Gender	Birth Year	Status	Origin	Residing Now?
709	F	1992	Alive	Rietfontein	Homob
710	F	1992	Alive	Rietfontein	Homob
711	F	1992	Alive	Rietfontein	Homob
712	F	1992	Alive	Rietfontein	Homob
713	F	1993	Alive	Rietfontein	Rietfontein

Excerpts from Research Field Notes: 1992 Africa Expedition, Etosha National Park

Date: *March 20*

Location: *Rietfontein Pride, Namibia*

Male 633 present along with females 628, 630, 664, 670, and 687. Male oldest animal in pride currently. Male limping?

Newer cubs discovered and tagged as 709, 710, 711, and 712. Unsure of parentage so samples were taken. Morphological measurements taken to determine comparable age. Seen most with females 628, 630, 687. Lone male 633 as father? Sending blood sample from male when checked by field veterinarian. Male 633 anesthetized to check leg, and blood and hair will be saved for genetic analysis.

Male 633 awake and moving OK.

628 and 630 may be sisters as they appear to be same age. Either of these two may be mother of 664, 670, or 687. Observed 664 and 670, which is a reminder that these females have been difficult to sample. Unsuccessful attempts have been made.

Date: *June 15*

Location: *Homob Pride, Namibia*

630 found in neighboring pride! Cubs 709, 710, 711, 712 all accounted for in new pride also. Sending blood samples from each to determine parentage. Cubs were trapped and checked by field vet. Blood samples taken for genetic analysis to be performed later. 630 presumed mother, locals calling her Lulu.

Excerpts from Research Field Notes: 1994 Africa Expedition, Etosha National Park

Date: *August 1*

Location: *Homob Pride, Namibia*

630 still a part of this pride. Cubs 709, 710, 711, 712 all accounted for and doing well. 709 appears to be male and other siblings appear to be female.

Date: *March 15*

Location: *Rietfontein Pride, Namibia*

630 seen back as part of this pride with new cubs. Cubs 709, 710, 711, 712 not present. 631 and 695 still patriarchs of pride.

Date: *March 30*

Location: *Homob Pride, Namibia*

710, 711, 712 present. 709 missing, presumably to another pride..

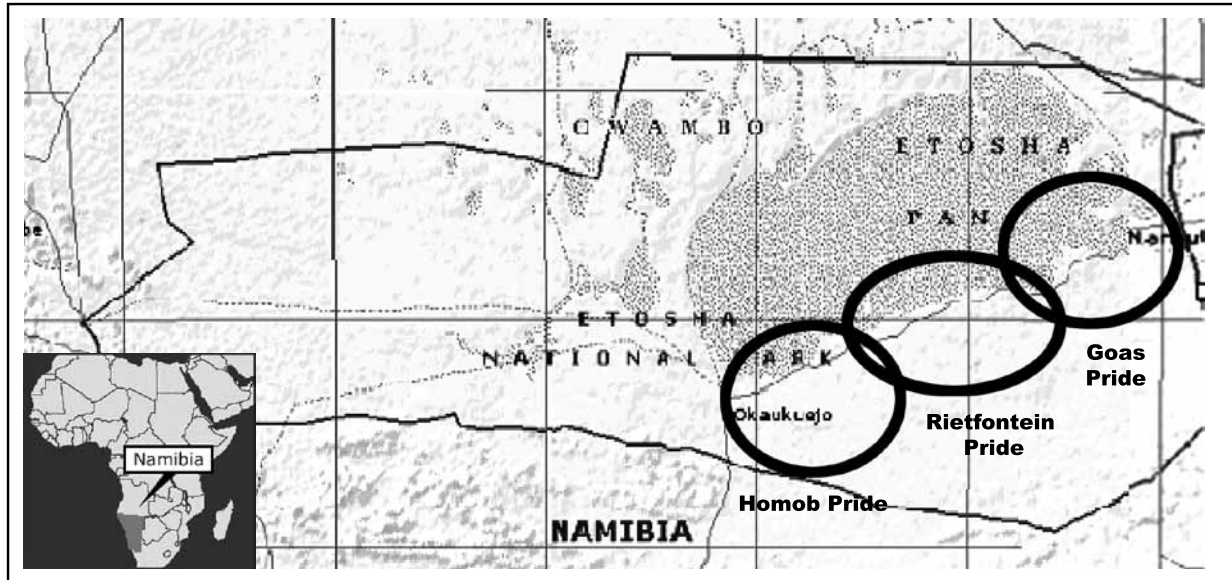
Will work on pedigree with new genetics data that have just come back. New cub 713 sighted. Samples taken.

Genetic Analysis Data

Once the DNA has been extracted from these lion blood samples, it can be analyzed to determine maternity and paternity. Starting on the next page, there are data tables for you to use when establishing the parentage of each cub.

Lion Geography

On the map below, label where each lion in the tables on page 46 originated, then draw arrows for each to show where they traveled. Use a different color for each lion. If the lion died or is no longer around, put a single line through its ID number. Be sure to fill in the key below the map to show each lion's color.



Etosha National Park, Namibia

Key:

Colors and/or Symbols used

Colors and/or Symbols used

628		657	
630		668	
664		709	
670		710	
687		711	
633		712	
631		713	
695			

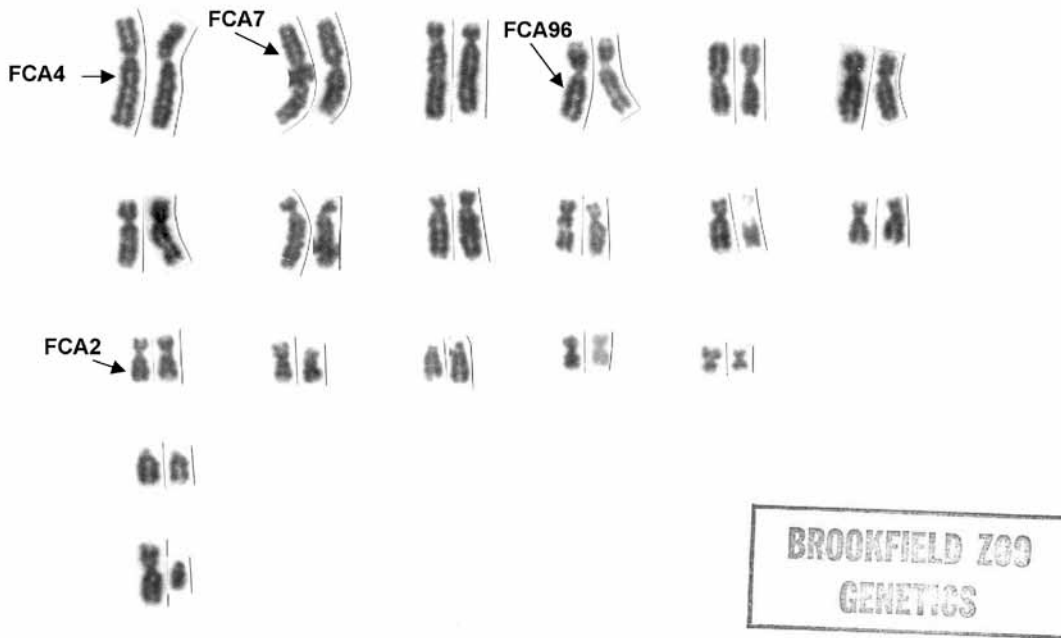


Lulu with cubs.



The cubs the following year.

African lion (*Panthera leo*) Metaphase chromosomes 2n = 38, male



Section A: These are the alleles that are present in this group of lions for each locus.

Section B: Genotypes are listed by locus for the group of adult males, adult females, and cubs that were present in the pride during the years observed.

Section C: This is the paternity data analysis.

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Instructions for data analysis:

1. For each cub, place an X for a mom if she shares an allele with the cub.
2. Find the lioness that has an X for each locus. Some of the possible mothers will not share alleles at one or more loci and are excluded as the mother. The real mother will have an X for all four loci.
3. For each locus, circle the allele in the cub's genotype that mom gave to the cub.
4. The other allele had to come from the dad. If a cub's genotype matches both alleles in the mom, then you can't tell which one mom gave, so the father could have given the cub either one. Write the father's allele in the box under each locus.
5. Look at the adult males listed and write down the ID number if he has that allele in his genotype.
Some males will share alleles at some but not all loci. Only the true father will share alleles with the cub at all loci.

Section A – Alleles				
Locus	FCA26	FCA45	FCA77	FCA96
Alleles	A	M	S	D
	B	N	T	E
	C	O	U	F
				G
				H

Section B – Genotype Data				
Females	FCA26	FCA45	FCA77	FCA96
628	A/B	M/N	S/S	D/D
630	B/B	M/N	S/U	E/H
687	C/C	M/N	T/U	D/G
Males	FCA26	FCA45	FCA77	FCA96
633	B/C	N/O	S/T	D/E
631	A/A	M/O	S/S	F/H
695	B/C	N/O	T/T	D/F
668	B/C	M/O	S/U	D/D
657	C/C	M/M	S/T	H/G
Cubs	FCA26	FCA45	FCA77	FCA96
709	A/C	M/M	S/S	D/D
710	A/B	M/N	S/U	D/D
711	B/B	M/O	S/T	E/H
712	C/C	M/O	S/U	E/G
713	A/B	M/O	S/S	D/F

Do the mother side first, then look for Dad.

Section C – Data Analysis										
		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	709	A/C	M/M	S/S	D/D	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	710	A/B	M/N	S/U	D/D	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	711	B/B	M/O	S/T	E/H	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	712	C/C	M/O	S/U	E/G	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

		FCA26	FCA45	FCA77	FCA96		FCA26	FCA45	FCA77	FCA96
Cub	713	A/B	M/O	S/S	D/F	Dad must have:				
Possible	628									
Moms	630									
	687									
	Mom is:					Dad is:				

Questions:

1. Are any of the cubs full siblings? If so, which ones? How do you know?
2. Did you find a mother for each cub? Why do you think this was the result?
3. Did you find a father for each cub? Why or why not?
4. Do your results agree with the field observations described at the beginning?
5. Write a summary explaining what Lulu did based on the field notes, as well as the DNA analysis.