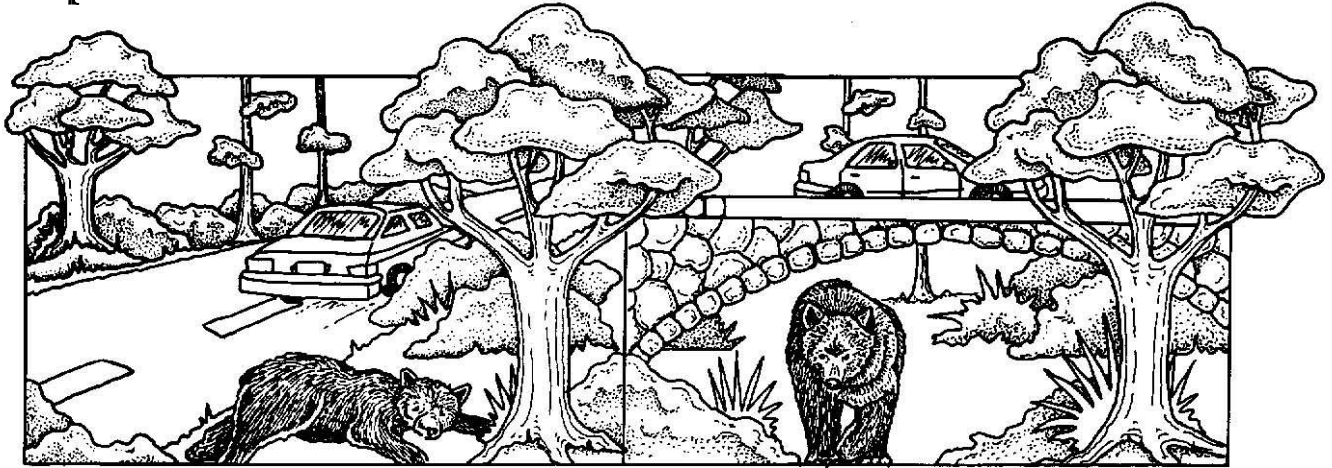


Population Problems



Key question

How does growth of Florida's human population affect bear populations?

Conceptual frameworks topics

- IV.C. Florida black bear seasonal activities and movements
- VI.B.3. Human-caused limiting factors – Roadkills
- VI.C. Human population growth and Florida black bear mortality
- IX.B. Strategies for reducing human-caused Florida black bear mortality

Subjects

Math, Science, Social Studies

Time estimates

45-60 minutes over one to two days

Key vocabulary

Population, roadkill

Supplemental video clip

[Time 15:09-18:34 of the 60 minute video](#)

Objectives

As part of this activity, students will:

1. Use information in a data table to construct line graphs illustrating human population growth in Florida over time and Florida black bear roadkills over time.
2. Interpret graphs to determine the relationship between human population growth and bear mortality due to roadkills.
3. Use information in a data table to construct a bar graph illustrating Florida black bear roadkills by month.
4. Interpret a graph to determine seasons of greatest black bear mortality due to roadkills.
5. Explain why black bear mortality due to roadkills varies seasonally and why more male black bears are killed on roads than female black bears.
6. Identify strategies to reduce black bear mortality due to roadkills.



Lesson Nine _____ Population Problems

Materials

Essential:

Per group of two to four students:

- One set of Population Problems [Data Tables 1 and 2](#)
- One set of Population Problems [Graphing Sheets 1 and 2](#)
- One Population Problems [Worksheet, Parts 1 & 2](#)
- One set of colored pencils
- One ruler

Supplemental:

Per class:

- Digital displays of blank Population Problems Graphing Sheets 1 and 2
- Recent news articles about Florida black bear roadkills in your local area

Per group of two to four students:

- Calculators

Background

Before European settlement, Florida had an estimated black bear population of 11,000 and an estimated human population of 350,000. Today, at least 4,000 Florida black bears share the state with over 20 million people. As discussed in the previous lessons, one of the primary factors threatening the continued success of the Florida black bear is habitat loss. As more and more land is cleared to make room for shopping malls, homes, schools, roads, and other facilities for Florida's steadily growing human population, less and less undisturbed, natural habitat is left for bears to inhabit. And unfortunately, most of the natural habitat that still remains is criss-crossed

with a network of roads. In addition to directly causing the death of bears as a result of collisions with vehicles, roads traversing black bear habitats also indirectly impact bear populations by isolating individuals from food sources, shelter, and potential mates.

Biologists at the Florida Fish and Wildlife Conservation Commission have been collecting information on and keeping records of the number of black bears killed on Florida roads for more than 30 years. The data indicate black bear mortality due to vehicle collisions is increasing. In fact, today, roads are considered the leading direct cause of Florida black bear mortality. As the population of people in the state increases, the number and size of roads and the number of vehicles on these roads also increases. Many major roads and highways, like Alligator Alley in south Florida, US 19/98 in the Panhandle, and State Road 40 in north-central Florida, are arteries connecting large urban centers and they cut directly across black bear habitat.

Like most other animals, black bears do not have a natural instinct to recognize the danger of roads or cars. When roads are built through their habitat, bears try to continue their normal movements. As they look for food, mates, or new habitat, many bears come in direct contact with moving vehicles. The number of Florida black bears killed by vehicles varies seasonally, primarily because bears roam more actively at different times of year



Lesson Nine _____ Population Problems

than others. Generally, the number of Florida black bears killed on Florida roads is highest in the fall (October, November, and December) because bears are traveling more extensively in search of enough food to get 20,000 calories a day to prepare for winter denning. There is also a slight peak in the number of Florida black bears killed by vehicles during early to mid-summer (May, June, and July) when adult male bears are searching for mates and subadult males are sent off on their own to establish ranges.

The number of bears killed on Florida's roads has remained above 200 bears each year since 2012. Vehicles killed a total of 231 black bears in 2016. With the total population of black bears in the state at about 4,000, that means that in the year 2016, 5.7 percent of the total black bear population was killed on Florida roads and highways.

With continued human population growth in areas bordering major bear habitats and pressure to widen some roads which pass through major bear habitats, bear mortality due to vehicle collisions will likely continue to remain high. However, several actions could be taken to help reduce the number of Florida black bear killed on roads. Relatively simple strategies include reducing speed limits and increasing the level of police enforcement of existing speed limits on roads and highways crossing major bear habitats, erecting warning signs in areas where bears are

frequently killed on roads, adding fencing around existing bridges to guide bears to cross under the bridge, and installing wildlife underpasses and barrier fences along roads and highways crossing major bear habitats. In areas like southwest Florida where highway underpasses have been installed, not only have black bear deaths from vehicle strikes declined, but the percentage of many other kinds of animals, like bobcat, Florida panther, raccoon, white-tailed deer, alligators, snakes, and turtles hit by vehicles have also declined. Other strategies to reduce vehicle strikes include guiding the construction of new roads away from the most favorable bear habitat and mitigating the impacts of widening of roads crossing known black bear habitats. Individuals can also take simple steps to prevent vehicle-bear strikes when driving through black bear habitats by driving more carefully, voluntarily driving more slowly, and keeping an eye out for bears, especially during dawn and dusk, when forest habitat is on both sides of the road, and when bear road signs are posted.

Today, the highest number of bears killed by vehicles occurs in Lake and Marion counties in the Ocala area. In 2016, 60 of the 231 total bears killed on roads in Florida were killed in those 2 counties. Continuing to work with the Florida Department of Transportation to install bear signs and underpasses on the state highways that traverse the Ocala National Forest will not only help reduce the number of bears and other wildlife killed on roadways, but also improve public



Lesson Nine _____ Population Problems

safety. About 2,000 known wildlife collisions occur each year on Florida's roadways, resulting in approximately 360 people being injured annually. These yearly collisions cause an estimated \$6,400,000 in damages. In addition, there have been two known human fatalities due to the direct impact between a vehicle and a bear on Florida's roads.

Advance preparation

1. Review the Population Problems Worksheet and add more challenging questions for advanced students or delete more difficult questions for lower-ability students as needed. Then prepare sufficient copies of the worksheet.
2. Prepare sufficient copies of Population Problems Data Tables 1 and 2 and Graphing Sheets 1 and 2.

Procedure and discussion questions

1. Introduce the lesson by writing the following information on the board:

1499	350,000	11,000
1970	6.8 million	300
2016	20.2 million	4,000

Ask students what they think these numbers represent. Continue accepting student responses until correct conclusions are drawn (the first column represents the year, the second column represents the estimated population of humans in Florida for these years, and the third column represents the

estimated population of black bears in the state for these years). Introduce the scientific definition of the term **population** as a group of organisms of the same species living in the same area.

2. Ask students to review the information on the board and answer the following questions:
 - How has the population of people living in Florida changed in the past 500 years?
 - How has the population of black bears living in Florida changed in the past 500 years?
 - Do you think there is any relationship between the number of people living in Florida and the number of black bears in Florida? If so, what do you think the relationship is?
3. Explain that during this mathematics lesson, students will be working in small groups to learn more about the impact of human population growth on Florida black bear populations. Tell students that since it is impossible to determine exactly how many Florida black bears are born and die each year, scientists can't keep track of the exact population of black bears in the state. Instead, they have to use



Lesson Nine _____ Population Problems

some other kind of data to figure out how human population growth affects Florida black bears and other wildlife species. Explain that one tool scientists use to measure the impact of human population growth on Florida black bear populations is a count of the number of bears killed on Florida roads each year. The term that can be used to describe an animal killed by a car, train, or other vehicle is called a **roadkill**. If available, pass around copies of recent news articles about a Florida black bear killed by a vehicle in your area. In Florida, biologists working for the Florida Fish and Wildlife Conservation Commission have been keeping detailed records of black bear roadkills since 1976. In the first graphing activity, students will work together to construct two line graphs to find out if there is a relationship between the number of people living in Florida and the number of black bear roadkills in the state.

4. Divide students into groups of two to four and distribute one copy of Population Problems Data Table 1, one copy of Population Problems Graphing Sheet 1, a set of colored pencils, and a ruler to each group. If calculators are available, give one to each group. Refer to the data table and explain that all the information on the chart is from

actual counts made by scientists. If necessary, review the procedure for reading a data table and constructing a line graph. Remind students that the first column marked "YEAR" is plotted on the horizontal axis of Graphing Sheet 1. Explain that students need to plot data points and connect them together to construct two separate line graphs on the same sheet: one graph illustrating the change in Florida's human population between 1997 and 2015 and one graph showing the change in number of black bears killed on Florida roads between 1997 and 2015. Tell students they should choose one colored pencil and use the **scale on the left side of Graphing Sheet 1** to plot the data points for the **human population of Florida** each year. After all data points for human population are plotted, they should use a ruler to draw lines connecting each data point.

5. Students should then choose a different colored pencil and use the **scale on the right side of Graphing Sheet 1** to plot the data points for the number of **Florida black bear roadkills during each year**. After all black bear roadkill data points are plotted, they should use a ruler and the second colored pencil to draw lines connecting these data points. When they are finished, they



Lesson Nine _____ Population Problems

should have two different colored lines on the same sheet. If necessary, display a blank copy of Graphing Sheet 1 to demonstrate the procedure for plotting and connecting data points.

6. After all groups have finished constructing the two line graphs, ask students to summarize their findings and describe what they can interpret from comparing the two graphs. Distribute a copy of the Population Problems Worksheet to each group and instruct groups to use the information on Data Table 1 and Graphing Sheet 1 to answer the questions on Part 1 of the worksheet. Have students share and discuss their responses. Make sure students realize that there is a correlation between human population growth in Florida and the number of black bear roadkills in the state. If you would like to introduce the concept of extrapolation, ask students to refer to their completed graphs and extend the graph lines of the two graphs to predict Florida's human population in 2016 and the number of Florida black bear roadkills in 2016. Have students share their predictions. Then explain that in 2016 Florida's human population reached close to 20.2 million, but the number of Florida black bears killed on roads

jumped from 143 in 2006 to 231 bears in 2016.

7. Ask students why they think Florida's human population growth is correlated in an increase in Florida black bear roadkills. Briefly review the five main reasons for the relationship:
 - As more people move to Florida, more natural bear habitat is developed for human use.
 - As bears lose their habitat, they are forced to find new areas in which to live and they often have to cross roads and highways in order to find new habitats.
 - As new areas of land are developed, more roads have to be built through black bear habitats.
 - As Florida's human population increases, the number of cars on roads passing through black bear habitat also increases.
 - As Florida's human population increases, many roads passing through black bear habitats have to be widened with passing lanes to accommodate increased traffic flow. Speed limits on these roads are usually higher, making it more dangerous for bears to cross them.



Lesson Nine _____ Population Problems

8. After this discussion is concluded, or on Day 2 of the lesson, distribute one copy of Population Problems Data Table 2 and one copy of Population Problems Graphing Sheet 2 to each group. Refer to the data table and explain that this information was collected by scientists and shows the actual number of Florida black bears killed on roads in the Ocala area for each month of 2016.
9. First, have groups fill in the blanks for the fourth data column (total number of black bears killed each month) and compute the total number of male bears and the total number of female bears killed during the entire year at the bottom of columns two and three.
10. Next, have groups use the information from the data table to construct a bar graph showing the number of Florida black bear roadkills by month for one year. Have one third of the groups construct a bar graph of female black bear roadkills by month, one third of the groups construct a bar graph of male black bear roadkills by month, and another third of the groups construct a bar graph of total black bear roadkills by month. If necessary, use a blank display of the Population Problems Graphing Sheet 2 to demonstrate the procedure for reading the data table and constructing a bar graph.
11. After all groups have finished constructing their assigned bar graphs, ask groups to summarize their findings and explain how they constructed their graphs to the other members of the class.
12. Next, ask students to describe what they can interpret about monthly black bear roadkills in the Ocala area from the three different graphs constructed: male black bear roadkills, female black bear roadkills, and total black bear roadkills. Refer to Part 2 of the Population Problems Worksheet and instruct groups to use the information on Data Table 2 and their completed Graphing Sheet 2 to answer the questions on the second part of the worksheet. Have students share and discuss their responses. Make sure students realize that black bear mortality is highest in fall because bears wander farther in search of food; and that roadkill rates are also slightly higher in early to mid-summer because bears are actively looking for mates and young adult male bears are trying to find and establish their own ranges. In addition, female bears have smaller home ranges and tend to wander less, especially when they are caring for cubs. Young adult females also tend to establish



Lesson Nine _____ Population Problems

home ranges nearer their mother's range in an area in which they are more familiar.

13. To conclude the lesson, ask students to brainstorm things they think could be done to reduce the number of Florida black bear roadkills and how they can personally help solve the problem. Record student responses on the board. Then review pertinent background information regarding proposed ideas for reducing Florida black bear mortality due to roadkills. Ideas may include reducing speed limits, erecting warning signs, installing barrier fences and underpasses in areas where Florida black bears live, and mitigating the impacts of new roads or the widening of roads in black bear habitats. Briefly discuss how the installation of underpasses in Lake and Collier County has reduced black bear mortality due to roadkills. Be sure to emphasize simple individual actions as well, such as driving more carefully and voluntarily driving more slowly through Florida black bear habitats.

Modifications for younger or ESE/ESOL students

1. Heterogeneously group students so that each small group contains at least one student with strong math/graphing skills. Have these

students help other group members with calculations and graphing activities.

2. Modify Data Table 1 and Graphing Sheet 1 and just have students create graphs of human population growth and black bear roadkills for the years 2011 and 2016.
3. Before preparing student copies of Graphing Sheet 1, complete the line graph of human population over time. Then, just have students complete a line graph of black bear roadkills over time on the same sheet.
4. Do not have students complete their own bar graphs for Data Table 2. Instead, let students refer to displays of completed bar graphs of male, female, and total monthly roadkills in order to complete Part 2 of the worksheet.
5. Have students answer questions on the Population Problems Worksheet orally instead of in writing.
6. Eliminate some of the more challenging math questions from the Population Problems Worksheet before preparing student copies.



Lesson Nine _____ Population Problems

Assessment suggestions

1. Collect completed copies of Graphing Sheet 1 from each group to determine if students correctly plotted data points and constructed the human population and black bear roadkill line graphs.
2. Review completed sections of Part 1 of the worksheet to determine if students correctly determined the relationship between human population growth and bear mortality due to roadkills.
3. Collect completed copies of Graphing Sheet 2 from each group to determine if students constructed an accurate bar graph of black bear roadkills by month.
4. Review completed sections of Part 2 of the worksheet to determine if students correctly determined the seasons of greatest black bear mortality due to roadkills.
5. Review completed sections of Part 2 of the worksheet to determine if students correctly explained why black bear mortality due to roadkills varies seasonally and why more male black bears are killed on roads than female black bears.
6. Ask students to orally list three different actions that could be taken to reduce Florida black bear mortality due to roadkills.



Population Problems Data Table 1

Year	Total Number of People Living in Florida (in millions)	Total Number of Florida Black Bears Killed on Florida Roads
1997	15.2	74
1998	15.5	89
1999	15.8	83
2000	16.0	109
2001	16.4	102
2002	16.7	133
2003	17.0	112
2004	17.3	130
2005	17.7	144
2006	18.0	143
2007	18.2	172
2008	18.3	157
2009	18.5	134
2010	18.8	168
2011	19.0	194
2012	19.1	285*
2013	19.3	234
2014	19.5	245
2015	19.8	248
Total	NA	2,956

*Note: The sharp increase in roadkills in 2012 is due to unknown causes.



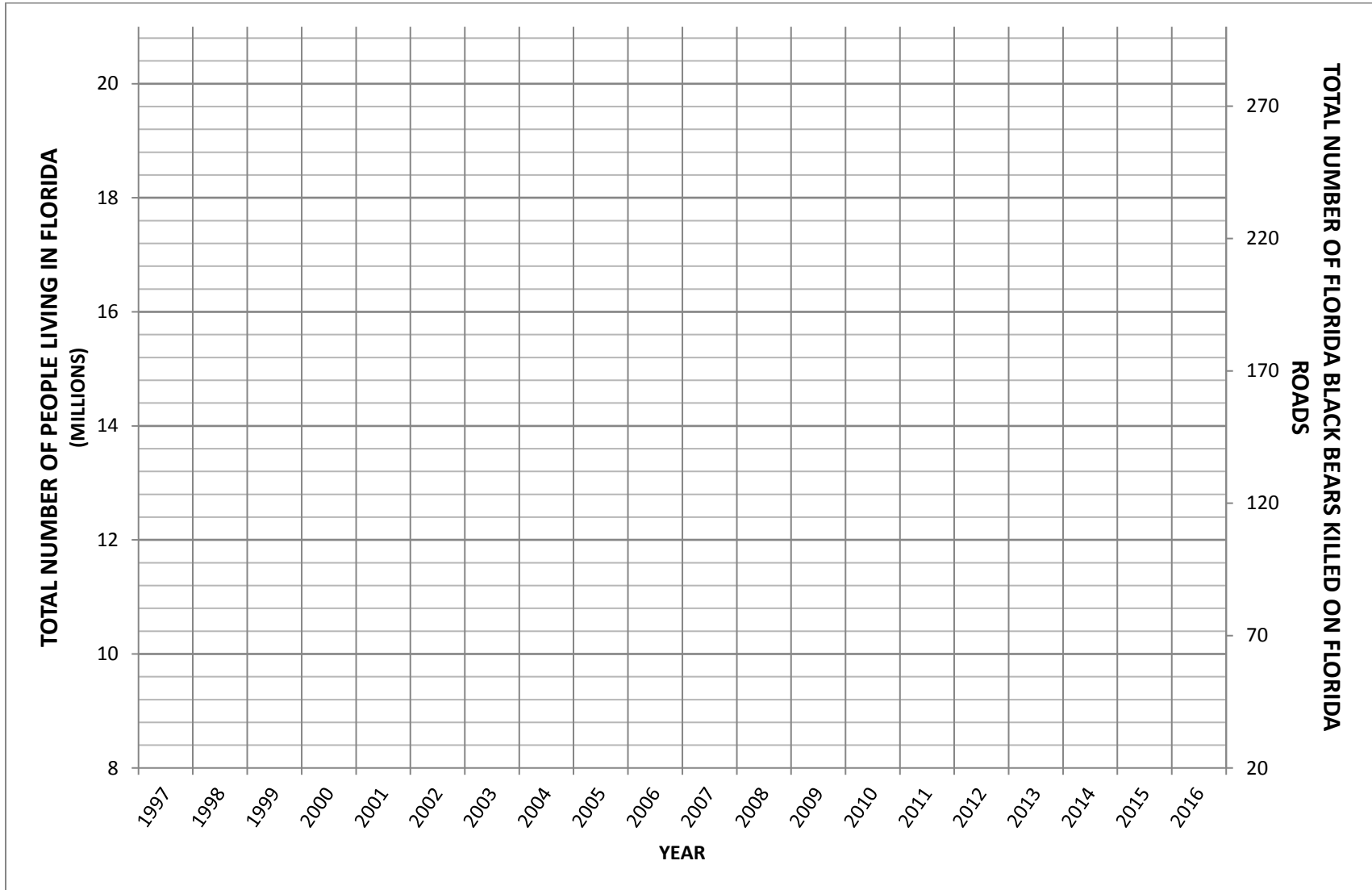
Population Problems Data Table 2

Month	Number of Bears Killed by Vehicles in Lake and Marion Counties in 2016		
	Males	Females	Total
January	3	1	
February	1	1	
March	0	1	
April	0	2	
May	3	2	
June	1	0	
July	2	1	
August	1	2	
September	2	1	
October	6	7	
November	11	4	
December	5	3	
Total			



Population Problems Graphing Sheet 1

Names _____



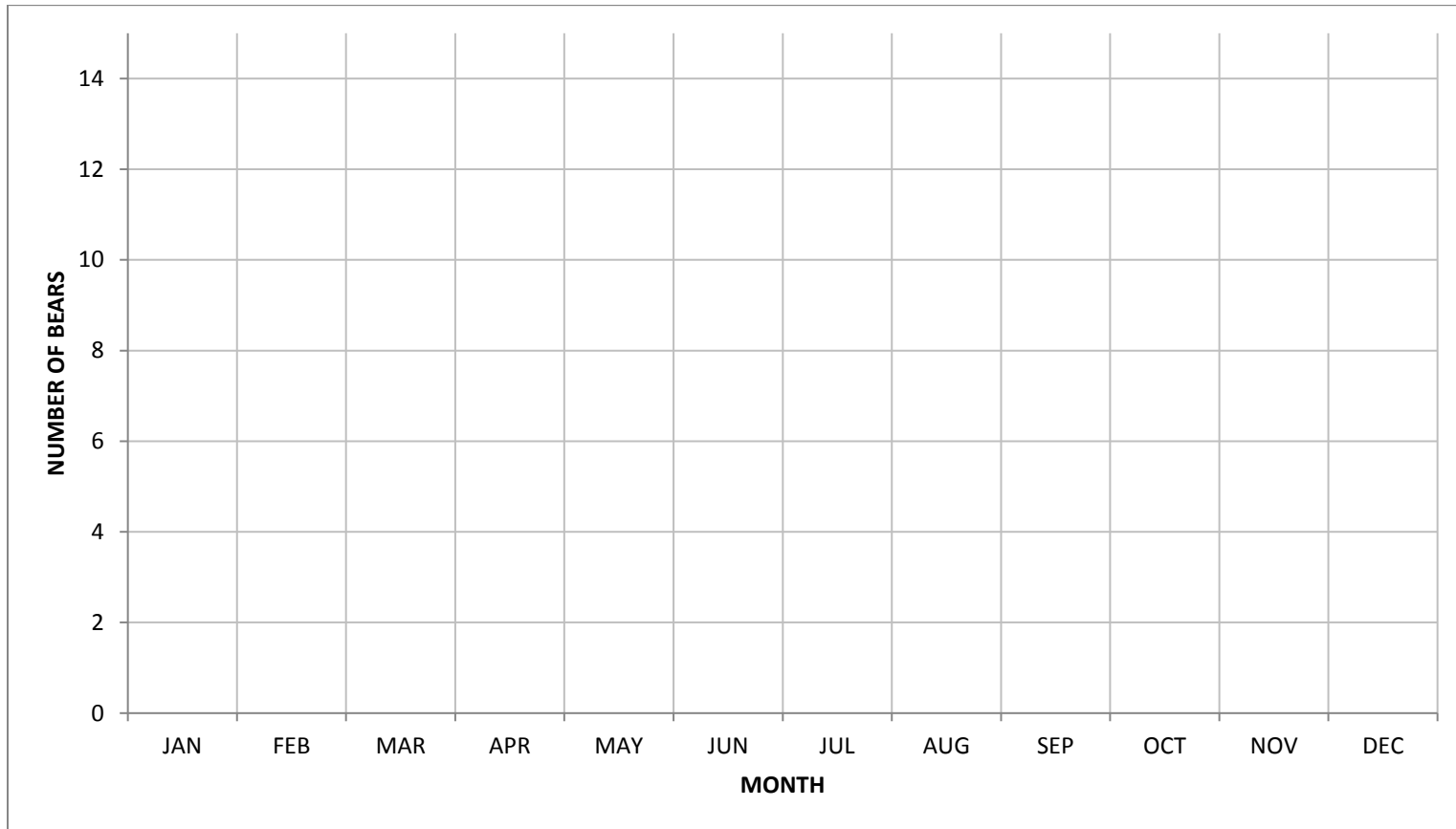
Population Problems Graphing Sheet 2

Names _____

(circle one)

NUMBER OF (MALE, FEMALE, TOTAL) BLACK BEARS KILLED BY VEHICLES

IN LAKE AND MARION COUNTIES, FLORIDA IN 2016



Population Problems Worksheet

Name _____

Name _____

Name _____

Name _____

Part 1

Directions: Use Data Table 1 and your completed Graphing Sheet 1 to answer these questions.

1. In what year were the fewest black bears killed on Florida roads? _____
2. In what year were the most black bears killed on Florida roads? _____
3. How many more Florida black bears were killed on Florida roads in 2016 than were killed on roads in 2006? _____
4. Between 2006 and 2016, in what year was the human population in Florida lowest? _____
5. Between 2006 and 2016, in what year was the human population in Florida highest? _____
6. By how many million people did the human population of Florida increase between 2006 and 2016? _____
7. Since 2006 how has the growth of Florida's human population correlated with the number of black bear roadkills? _____

8. How could an increase in the number of people in Florida lead to an increase in the number of black bear roadkills? _____



Population Problems Worksheet

Name _____

Name _____

Name _____

Name _____

Part 2

Directions: Use Data Table 2 and your completed Graphing Sheet 2 to answer these questions.

1. How many total male black bears were killed on roads in Lake and Marion Counties in 2016? _____
2. How many total female black bears were killed on roads in Lake and Marion Counties in 2016? _____
3. How many total male and female black bears were killed on roads in Lake and Marion Counties in 2016? _____
4. In what months were the most black bears killed on roads in Lake and Marion Counties? _____
5. In what months was the greatest number of male black bears killed on roads in Lake and Marion Counties? _____
6. In what months was the greatest number of female black bears killed on roads in Lake and Marion Counties? _____
7. Based on these monthly totals, during which season of the year do most black bear roadkills occur? _____



Population Problems Worksheet Continued

8. Why do you think black bear roadkills are more common during the season you answered in question 7?

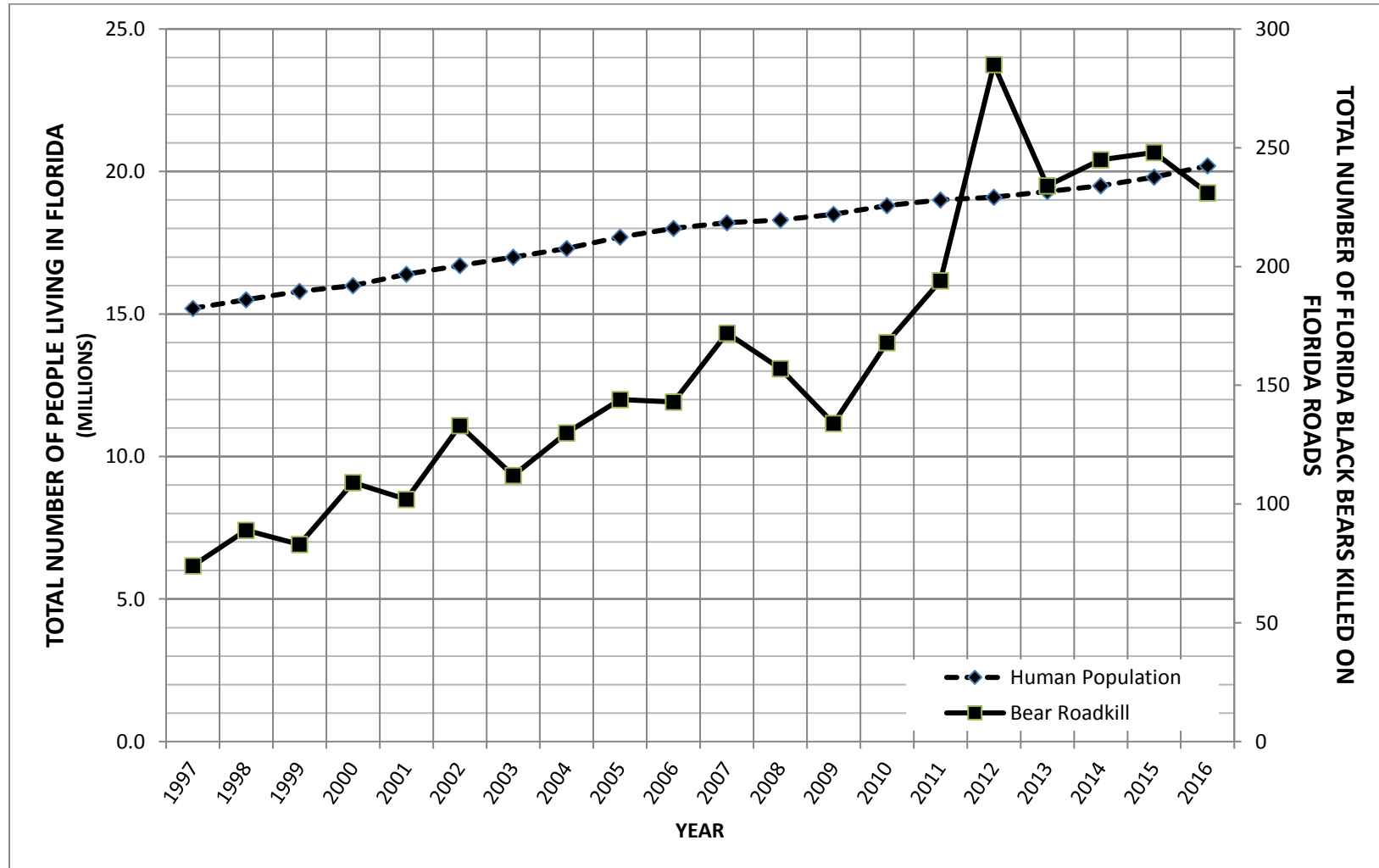
9. Which kind of black bear, male or female, seems to get killed on roads more often? _____

10. Why do you think your answer in question 9 gets killed on roads more often than the other choice? _____



Population Problems Graphing Sheet 1

Figure 1 – Sample completed graph for human population growth and bear roadkills over time

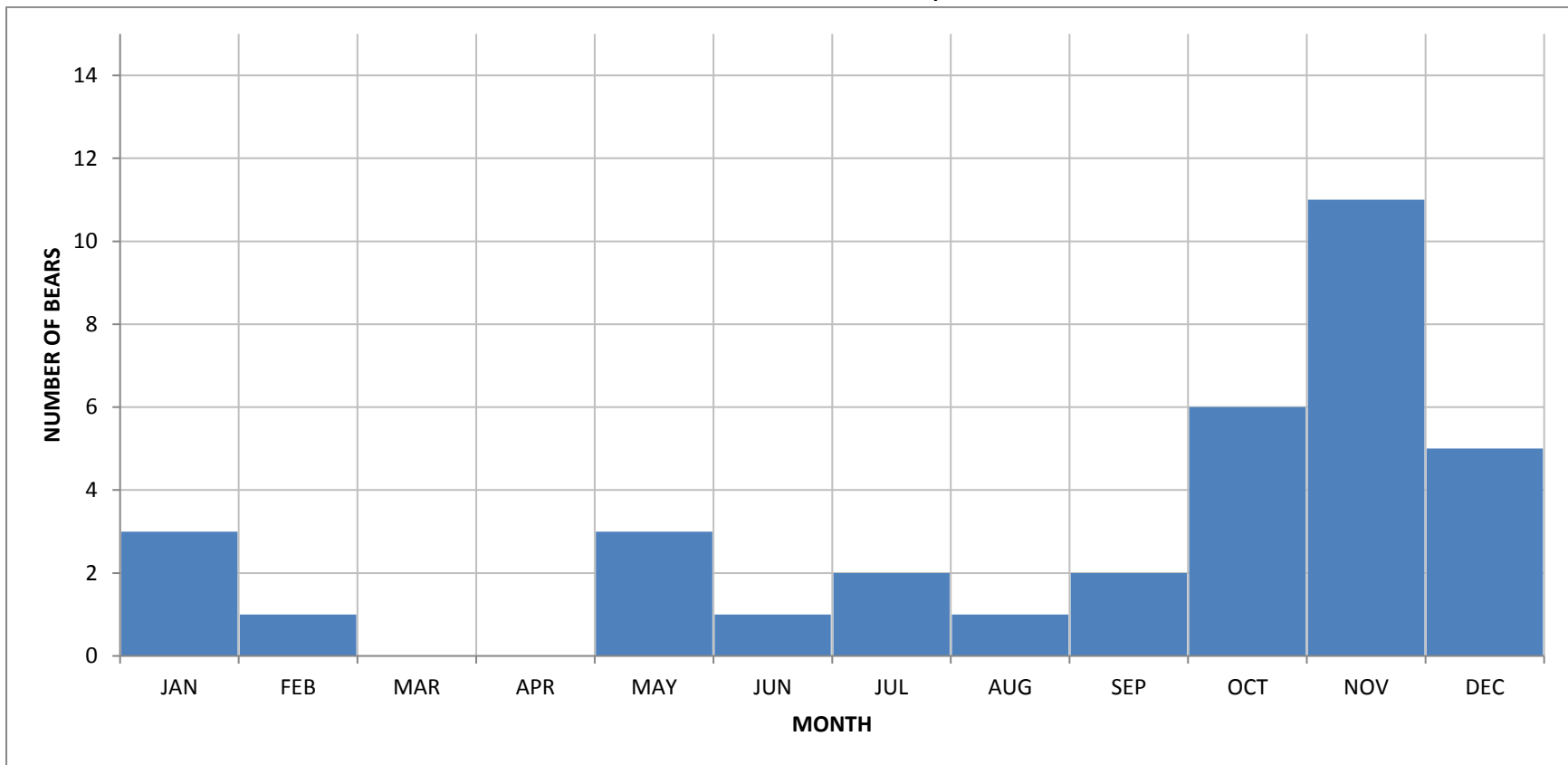


Population Problems Graphing Sheet 2

Figure 2 – Sample completed graph for male black bears

(circle one)
NUMBER OF (MALE, FEMALE, TOTAL) BLACK BEARS KILLED BY VEHICLES

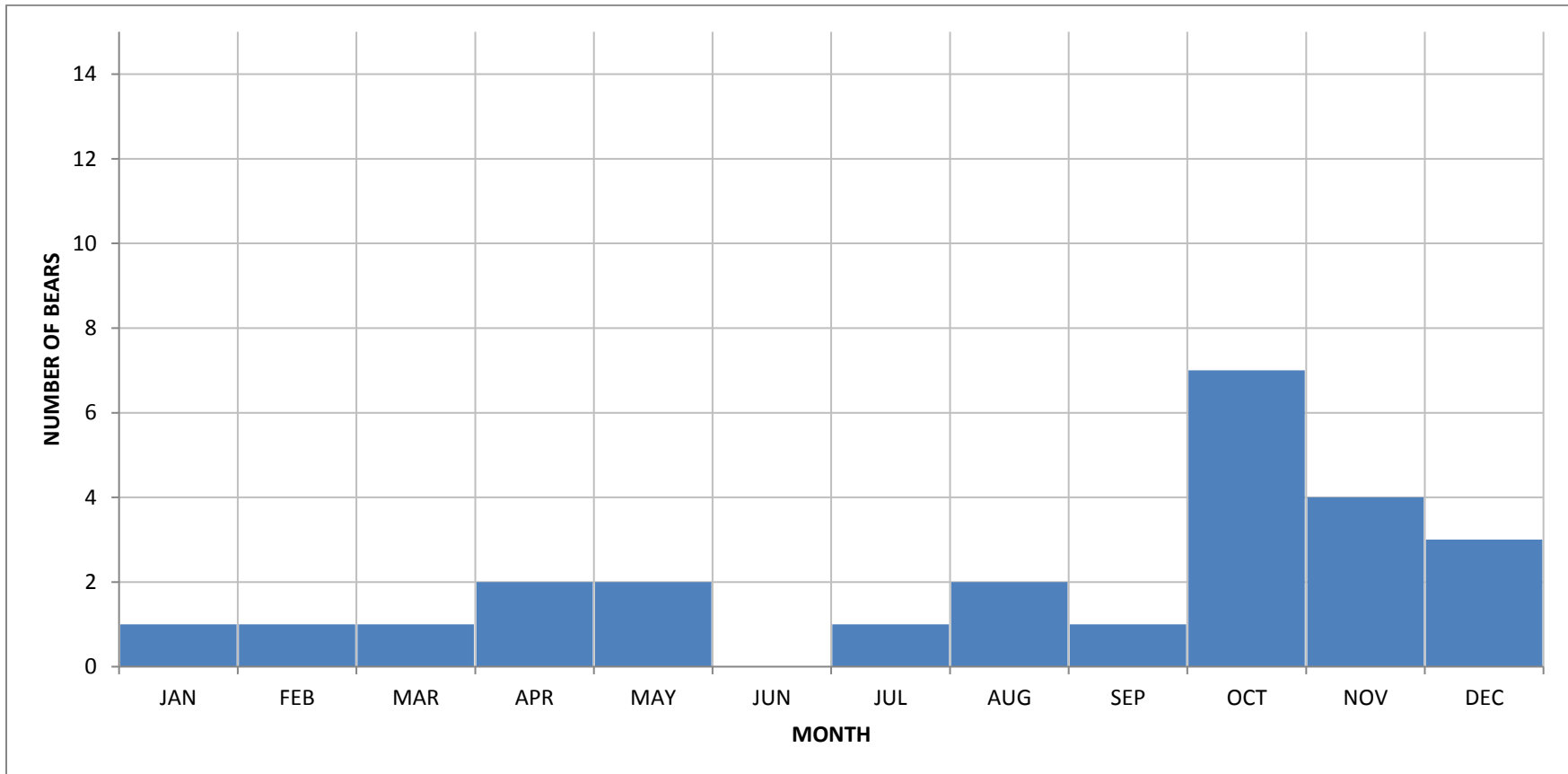
IN LAKE AND MARION COUNTIES, FLORIDA IN 2016



Population Problems Graphing Sheet 2

Figure 3 – Sample completed graph for female black bears

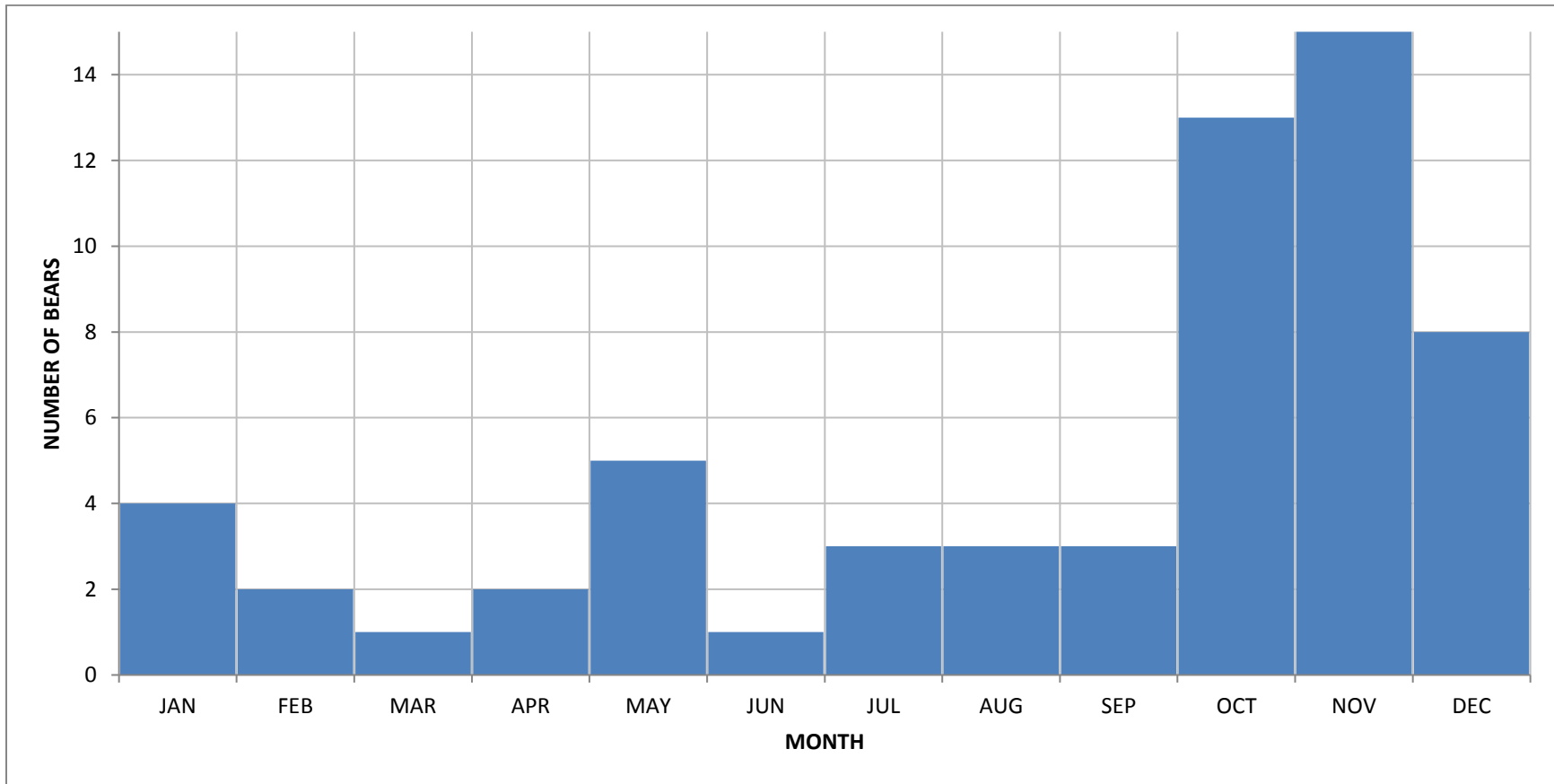
NUMBER OF (MALE, ^(circle one) FEMALE, TOTAL) BLACK BEARS KILLED BY VEHICLES
IN LAKE AND MARION COUNTIES, FLORIDA IN 2016



Population Problems Graphing Sheet 2

Figure 4 – Sample completed graph for **total** black bears
(circle one)

NUMBER OF (MALE, FEMALE, **TOTAL**) BLACK BEARS KILLED BY VEHICLES
IN LAKE AND MARION COUNTIES, FLORIDA IN 2016



Population Problems Worksheet Answer Key

Part 1

Directions: Use Data Table 1 and your completed Graphing Sheet 1 to answer these questions.

1. In what year were the fewest black bears killed on Florida roads? **(1997)**
2. In what year were the most black bears killed on Florida roads? **(2012)**
3. How many more Florida black bears were killed on Florida roads in 2016 than were killed on roads in 2006? **(88)**
4. Between 2006 and 2016, in what year was the human population in Florida lowest? **(2006)**
5. Between 2006 and 2016, in what year was the human population in Florida highest? **(2016)**
6. By how many million people did the human population of Florida increase between 2006 and 2016? **(2.2 million)**
7. Since 2006, how has the growth of Florida's human population correlated with the number of black bear roadkills? **(As Florida's human population has grown, the number of black bear roadkills has increased and now remains above 200)**
8. How could an increase in the number of people in Florida lead to an increase in the number of black bear roadkills? **(More people lead to an increase in the development of natural bear habitat resulting in bears to wander across roads looking for new places to live. More people also result in a need for more roads to be built through bear habitats. An increase in the number of people also leads to an increase in the number of cars traveling on roads crossing through bear habitats, thus increasing the likelihood of a collision with a bear. An increase in the number of people also leads to a need to widen roads crossing through bear habitats to accommodate the increased traffic flow. Wider roads are harder for bears to cross, thus increasing the likelihood of a roadkill.)**



Population Problems Worksheet Answer Key

Part 2

Directions: Use Data Table 2 and your completed Graphing Sheet 2 to answer these questions.

1. How many total male black bears were killed on roads in Lake and Marion Counties in 2016? **(35)**
2. How many total female black bears were killed on roads in Lake and Marion Counties in 2016? **(25)**
3. How many total male and female black bears were killed on roads in Lake and Marion Counties in 2016? **(60)**
4. In what months were the most black bears killed on roads in Lake and Marion Counties? **(October and November)**
5. In what months was the greatest number of male black bears killed on roads in Lake and Marion Counties? **(October and November)**
6. In what months was the greatest number of female black bears killed on roads in Lake and Marion Counties? **(October and November)**
7. Based on these monthly totals, during which season of the year do most black bear roadkills occur in Lake and Marion Counties? **(Fall)**
8. Why do you think black bear roadkills are more common during this time of year? **(Black bears are roaming more widely in search of enough food to get 20,000 calories a day.)**
9. Which kind of black bear, male or female, seems to get killed on roads in Lake and Marion Counties more often? **(Male bears)**
10. Why do you think your answer in question 9 gets killed on roads more often than the other choice? **(Male bears have a larger home range and travel more than female bears. Also, in the late spring, young adult male bears are forced to move away from their birthplace to find and establish their own home ranges.)**

NOTE: Human population numbers gathered from <http://edr.state.fl.us/>

