

# SCIENCE·3D

## CROCODILE COUNTRY

In this packet, sample student answers are provided in **red** and notes to teachers are in **blue**.

In this **Science Mission**, students will explore how the seasons and the size of crocodiles affects their diet. They will decide if crocodiles are carnivores or omnivores. Finally, students will investigate where crocodiles are found in different seasons. They will synthesize the information they have to determine when and where crocodiles might be a risk to people, livestock, and pets. In this activity, students will develop hypotheses and predictions and test them by analyzing data. They will make bar graphs and pie charts and interpret graphs and maps. An optional activity will have students explore how crocodiles and their habitat might be affected by invasive species.

*Note: Students will need drawing tools of different colors to create bar graphs and pie charts. Otherwise, they will have to draw graphs and fill the bars with different patterns to represent different groups.*



## Activity 1: When Do Crocodiles Eat?

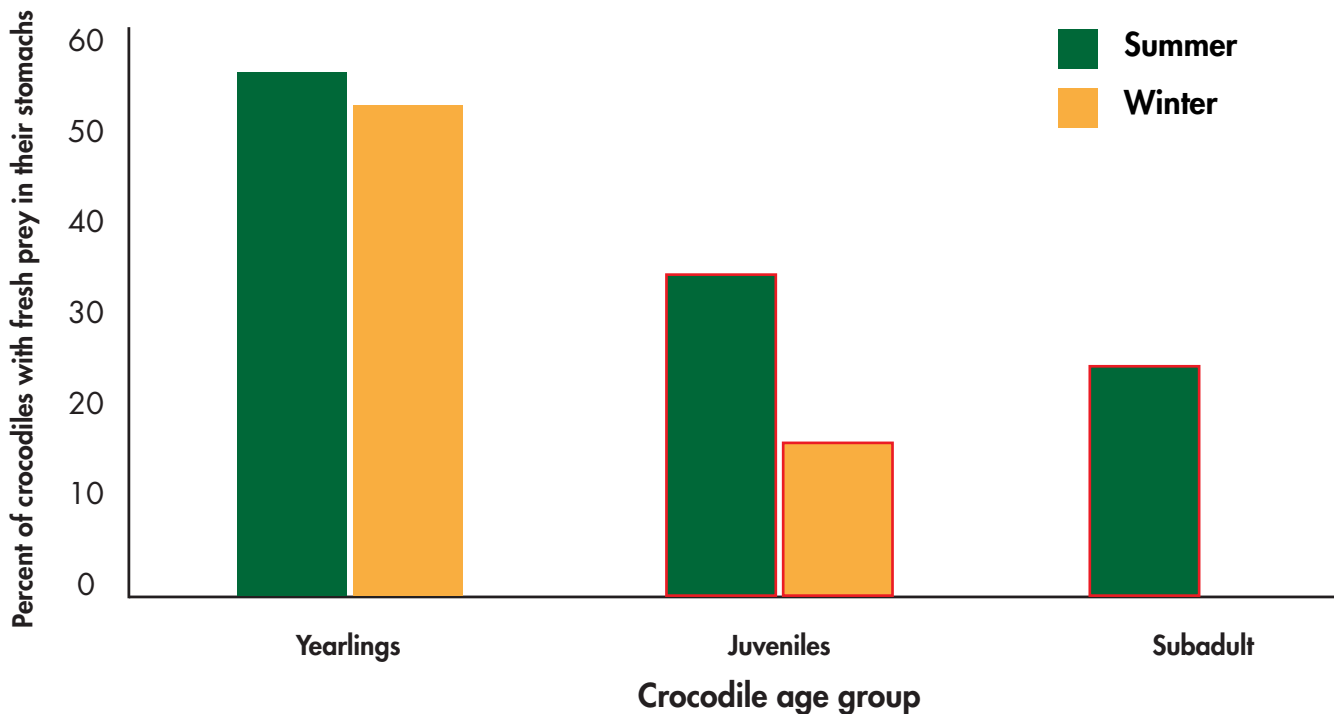
To protect crocodiles, we have to protect their prey. To protect people, pets and livestock, we have to know at what size crocodiles might be dangerous. We know that adult crocodiles can be dangerous, but what about smaller crocodiles? One way to see what they eat is to study what is in their stomachs. When a crocodile is caught, scientists can use water to wash prey out of their stomachs.

First, let's see how often crocodiles might eat. One way to do this is to calculate the percent of crocodiles that have fresh prey in their stomachs.

**Table 1. Percent of crocodiles with fresh food in their stomachs in winter and summer**

|        | Yearlings | Juveniles | Subadults |
|--------|-----------|-----------|-----------|
| Summer | 55        | 33        | 23        |
| Winter | 53        | 16        | 0         |

- Use the data from Table 1 to **Complete** the bar graph in Figure 1 to show how the percent of crocodiles with fresh food in their stomachs differs in summer and winter. The first bars are completed for you.



**Figure 1. Percent of crocodiles with fresh food in their stomachs in winter and summer across three age groups**

2. Look at the data from the summer months in your graph. Use these data to **predict** how often crocodiles of different sizes eat. Use the graph to support your answer. *Hint: More animals with fresh food in their stomachs probably means they eat more often.*

Bigger crocodiles seem to eat less often than smaller ones. As crocodiles grow, a smaller percent of crocodiles have fresh food in their stomachs.

3. The sample in Table 1 did not include any adult crocodiles. **Predict** whether adult crocodiles will feed more or less often than smaller crocodiles. Use data from your graph to support your answer.

I think adults will feed less often. Bigger and bigger crocodiles have less fresh food in their stomachs less often.

4. **Describe** how you might test your hypothesis from question 3.

Answers will vary. Example: I would catch adult crocodiles and wash their stomachs out. I would see what percent have food in their stomachs.

5. **Describe** how the amount of feeding changes between summer and winter. Do all sizes of crocodiles follow the same pattern? Use data from Figure 1 to support your answer.

Changes in feeding across the seasons changes with the size of crocodile. Yearlings feed the same amount in winter and summer. The same percent of crocodiles have fresh food in their stomachs. Juvenile crocodiles feed more in the summer than winter. And, subadults don't seem to feed much at all during the winter. No subadults had fresh food in their stomachs in winter.

6. **Predict** whether the danger from adult crocodiles would be different in the winter and summer. Use data from your graph to support your answer.

I think risk would be higher in the summer since it doesn't look like big crocodiles eat much in winter.

**Extend the Lesson:** Lead a discussion asking students why they think that crocodiles that are big might eat less in winter but yearlings have to eat all year round. Students should understand that yearlings need a lot of food to grow, so they need to eat year-round. But, larger crocodiles don't have to eat much in winter. This is because they are ectotherms. As their body temperature goes down, they need less food.

## Activity 2: What Do Crocodiles Eat?

**Table 2. Percent of different types of prey eaten by crocodiles of different Ages**

|                         | Yearlings<br>(< 80 cm) | Juveniles<br>(80 cm - 135cm) | Subadult<br>(135 cm - 225 cm) |
|-------------------------|------------------------|------------------------------|-------------------------------|
| <b>Invertebrates</b>    |                        |                              |                               |
| Insects                 | 42                     | 38                           | 17                            |
| Spiders                 | 42                     | 34                           | 8                             |
| Crustaceans             | 0                      | 7                            | 0                             |
| <b>Vertebrates</b>      |                        |                              |                               |
| Fish                    | 8                      | 10                           | 67                            |
| Reptiles and Amphibians | 5                      | 7                            | 0                             |
| Mammals                 | 3                      | 4                            | 8                             |

**Extend the Lesson:** Reinforce standards about classification. Have students list the characteristics of each of the animal groups in the table above. Have them investigate other major groups of vertebrates and invertebrates. Have students list their characteristics and speculate why they may not be eaten by Nile crocodiles.

1. **Complete** Table 3 below by using the data in Table 2 to determine the percent of the crocodiles' diet that is invertebrates or vertebrates.

**Table 3. Percent of crocodile diets made up of vertebrates and invertebrates**

|                      | Yearlings<br>(< 80 cm) | Juveniles<br>(80 cm - 135cm) | Subadult<br>(135 cm - 225 cm) |
|----------------------|------------------------|------------------------------|-------------------------------|
| <b>Invertebrates</b> | 84%                    | 79%                          | 25%                           |
| <b>Vertebrates</b>   | 16%                    | 21%                          | 75%                           |

2. **Draw** pie charts showing the diet for each crocodile age group based on the data in Table 3. For an example of a pie chart, see the examples after question 3 below. Label what each color in your chart represents.



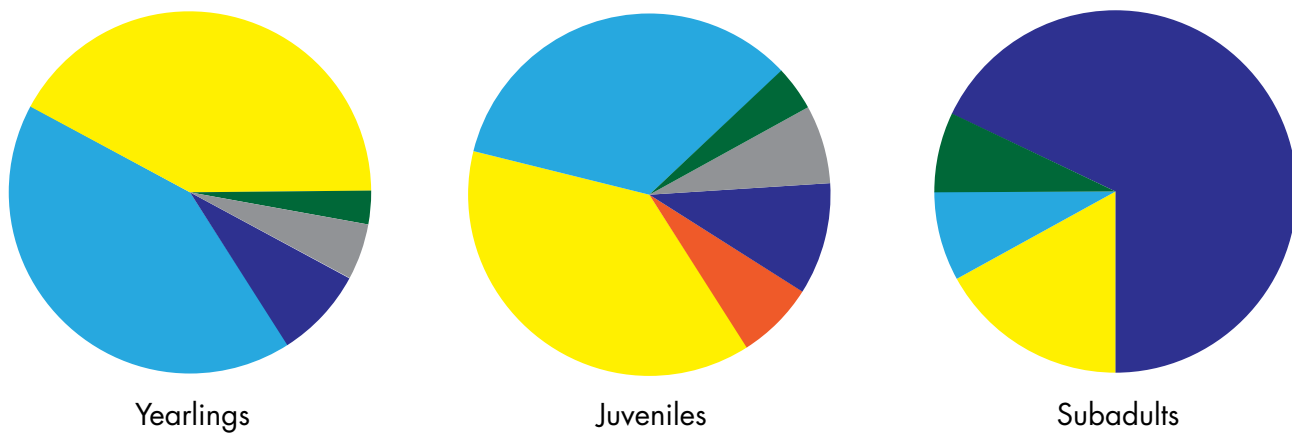
3. **Describe** how the diet of crocodiles changes as they grow based on the pie charts you drew. Use information from your pie charts to support your answer.

*As crocodiles grow, they eat more vertebrates. Yearlings and juveniles eat mostly invertebrates.*

*Subadults eat mostly vertebrates.*

**Extend the Lesson:** Have students use a spreadsheet to create the pie charts.

The data from Table 2 are shown in the pie charts below.



**Figure 2.** Pie charts showing the percent of the diet of crocodiles made up of fish, amphibians and reptiles, mammals, insects, spiders, and crustaceans

Extra information to discuss with your students: The mammals that crocodiles in these size classes eat are small, mainly rodents like mice. The spiders and insects that the crocodiles eat are species that live on the water's surface or in the water. For example, these include spiders that eat small fish or water bugs.

4. **Describe** how the diets of crocodiles change with their size. Use the pie charts in Figure 2 and Table 2 to support your answer.

Yearlings eat mostly insects, spiders, and a few fish. Juveniles eat a bit more fish and some crustaceans that yearlings don't eat. Subadults eat mostly fish. They eat more mammals than smaller crocodiles. They don't eat as many insects and spiders.

5. **Compare** and **contrast** the information in the pie charts you drew with those in Figure 2. What do they show you about how crocodile diets change?

The pie charts with more species gives more detail. Both types show that subadult crocodiles eat mainly vertebrates. Younger crocodiles eat mostly invertebrates. The second set of pie charts shows what kinds of vertebrates and invertebrates crocodiles eat.

6. **Predict** whether yearling, juvenile, and subadult crocodiles might be a threat to people or pets. Use data to support your answer.

I don't think juveniles and yearlings are a risk. They eat almost all insects and spiders.

Subadults may be a little bit of a risk to pets. They eat some mammals, but most of their food is fish.

Crocodiles had some matter in their stomachs that was not from animals! Figure 3 shows the percent of crocodiles in each age group that had different materials in their stomachs.

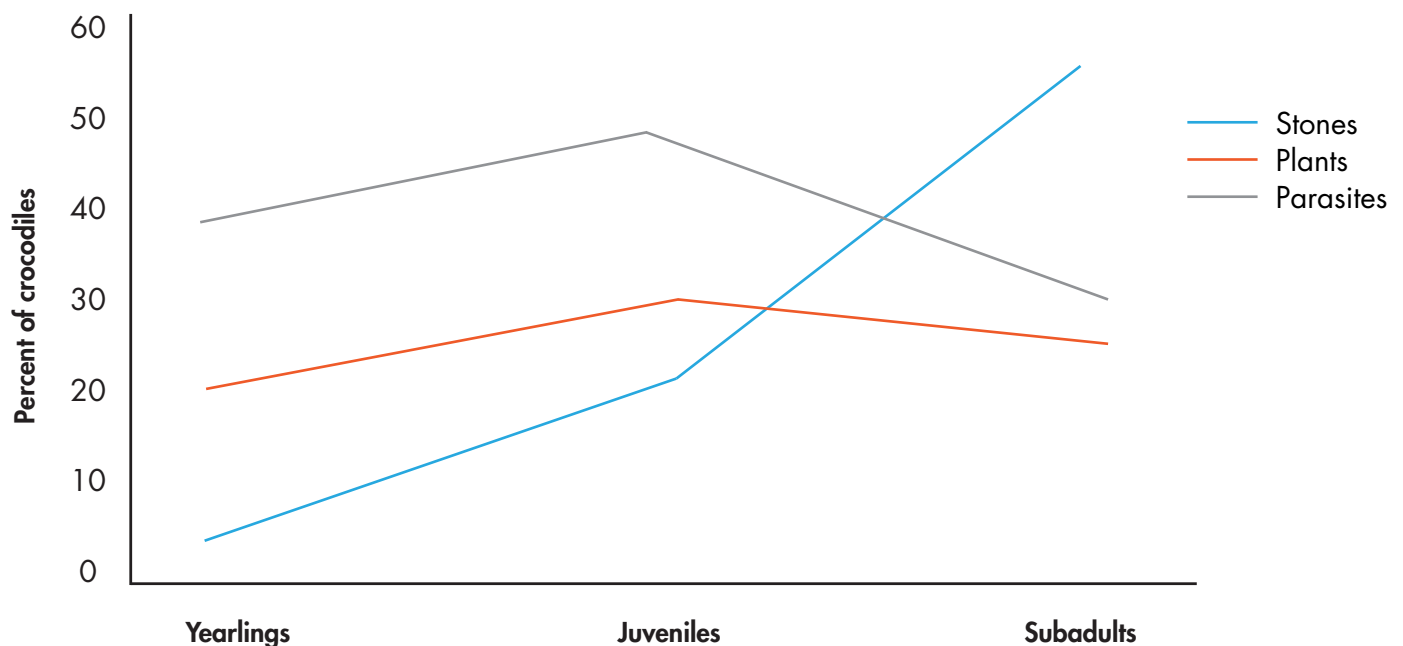


Figure 3. Percent of crocodiles of three sizes with stones, plant matter, or parasites in their stomachs

7. Do you think that crocodiles are *carnivores* (only eat meat) or *omnivores* (eat plants and animals)? **Cite** evidence from Figure 3 to support your answer.

I think they are omnivores because about 25% crocodiles of all sizes have plants in their stomach.

8. **Describe** whether there is information in Figure 3 that was not needed to answer question number 7.

Yes, I did not need to know about stones and parasites in the stomachs of crocodiles to decide whether they are omnivores.

**Extend the Lesson:** Have students speculate on why crocodiles have stones in their stomachs (it is actually to help them break down their foods). Have them think about why the proportion of crocodiles with stones in their stomach changes with size (bigger crocodiles need stones to help break down larger prey and are big enough to swallow stones). You can also use the data in Figure 3 to begin a discussion of parasites and different interactions in the Okavango ecosystem.

### Activity 3: Do Crocodiles Respond to People?

To understand how often crocodiles might come into human territory, we want to know how they respond to humans. If crocodiles avoid humans, then it may not be common for there to be problem crocs. If they are moved, they may be less likely to come back. But if crocodiles are perfectly happy near people there might be a bigger problem.

Crocodiles can be especially dangerous when they are guarding their nests. The team has been measuring where Nile crocodiles nest. Table 4 shows where they found nests in a part of the Okavango where there are fewer people. It also shows five years of nesting where there are many people. One important part of the study is that people don't use river channels that are full of papyrus ("papyrus channel"). They spend most of their time in the main channel.

1. **Predict** where you will see most crocodile nests when there are a lot of humans around (the main channel or papyrus-filled channels). **Describe** why you made this prediction.

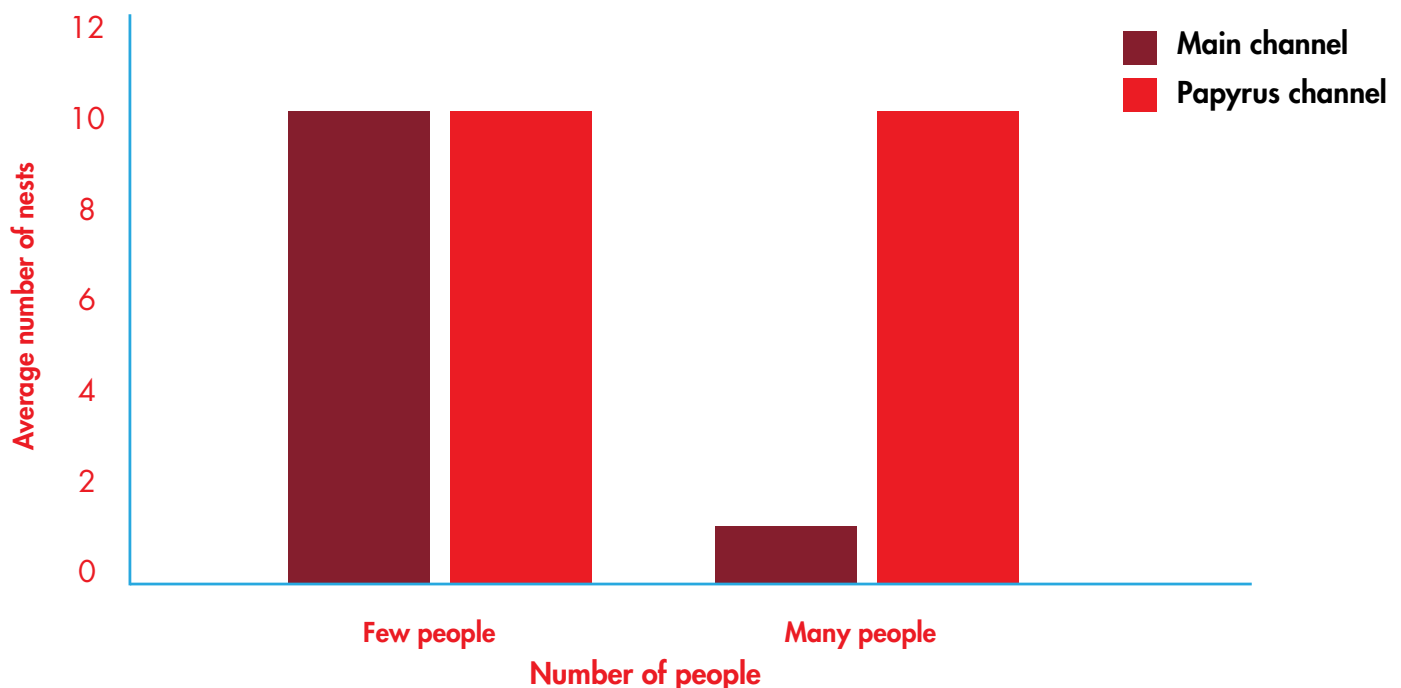
I predict that there will be more nests in the papyrus-filled channels when people are around because people can't get there to disturb or hurt the crocodiles. Other predictions are acceptable as long as they are supported with good reasoning. Note, if students make predictions other than the suggested answer, they will have a different answer to question 4.

2. **Complete** Table 4 by calculating the average number of nests in each area. *Hint: Add up all the numbers in a column and divide by 5.*

**Table 4. Number of crocodile nests in different habitats in locations where there are many people and few people**

|                | Few people   |                 | Many people  |                 |
|----------------|--------------|-----------------|--------------|-----------------|
|                | Main channel | Papyrus channel | Main channel | Papyrus channel |
| 1              | 10           | 11              | 2            | 10              |
| 2              | 9            | 12              | 1            | 12              |
| 3              | 12           | 9               | 1            | 11              |
| 4              | 10           | 8               | 1            | 8               |
| 5              | 9            | 10              | 0            | 9               |
| <b>Average</b> | <b>10</b>    | <b>10</b>       | <b>1</b>     | <b>10</b>       |

3. **Draw** a bar graph to show how the average number of nests differs between habitats. Label the axes and write a figure title.



**Number of nests in different habitats when there are a lot of people and when there are few people**

*Note: Students may do slight variations on the graph above. They may label each bar for the habitat and people and spread them evenly. They may group habitats. The specifics of layout are not critical.*



4. **Describe** how nesting crocodiles respond to the presence of people. **Analyze** whether your prediction from question 1 was supported. Use your graph to support your answer.

Answers may vary depending on the prediction made in question 1; the answer should be consistent with their predictions. If the prediction was consistent with the suggested answer, a complete answer includes: When people are around, crocodiles infrequently use main channels. They nest mainly in papyrus habitats. This supports my prediction. When there were not many people, crocodiles nested in the main channel.

Where are adult crocodiles that are not nesting found? Do they avoid the areas where there are a lot of people? Do they not care if people are around? The team has surveyed a portion of the Okavango Delta to find out. The map below shows the main channel of the river leading into the Okavango Delta as a thick blue line. Thin blue lines are smaller channels. Most of the dark green area has wetlands where crocodiles can live. The light green areas are places with many people. The places that crocodiles were seen over two years are marked with blue triangles (Year 1) and orange circles (Year 2).

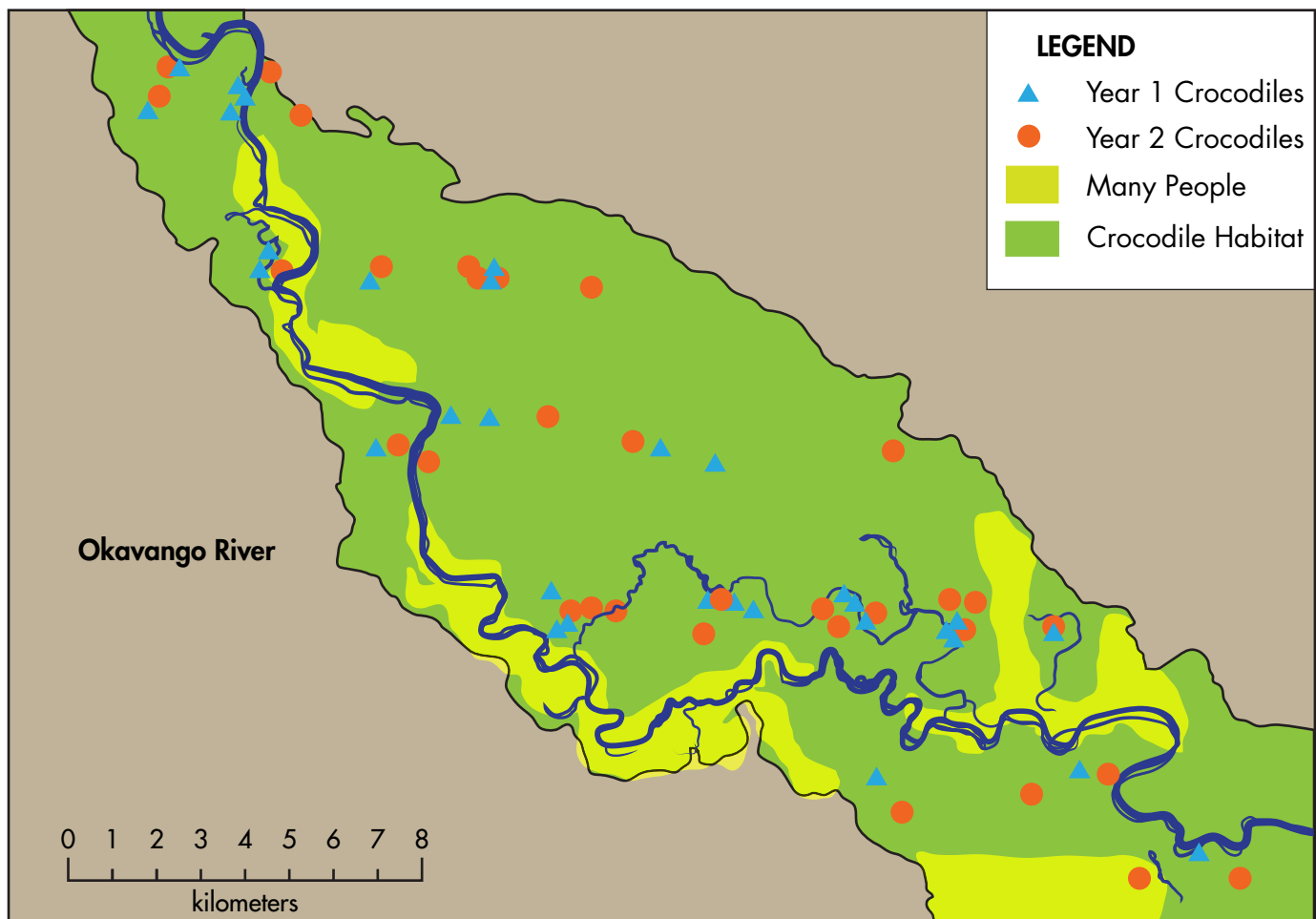


Figure 4. Locations of adult crocodile sightings in two years

5. Based on Figure 4, do you think that crocodiles tend to avoid people or tend to be found near people? Use evidence from your map to support your answer.

I think that crocodiles tend to avoid people. There are few crocodiles seen in areas where there are a lot of people and there are quite a few outside the areas where people might disturb them.

6. **Predict** whether moving a crocodile might help protect people and pets. Do you think they will come back quickly? Use evidence from Figure 4 and your investigation of crocodile nests to support your answer.

Accept reasonable answers that make a logical argument. A good answer includes: I think moving crocodiles is a good idea. Adult crocodiles tend to be found where there are fewer people and crocodiles usually don't build nests where they might see people. I think they will stay far away after they are moved.

7. **Describe** how you would test your prediction from question 6.

Accept reasonable answers. This question is designed to get students thinking about how to test their ideas. Students may respond that they would catch crocodiles that are too close to people, put a tag on them, and see if they come back. They may also say they would put a tracking device on the animal and see where it goes.

## Activity 4: Predict What Might Happen

This optional activity links to standards on how organisms can change their environment and how people can influence ecosystems. This activity links to one of the alternate **Explore Your Backyard** activities that has students investigate invasive species in a local ecosystem.

Crayfish are crustaceans. They look like little lobsters. They are not naturally found in the Okavango Delta. They are not native. They are an invasive species in southern Africa. Even though invasive species are not naturally found in an area, their populations can grow large and have a big effect on local animals. Crayfish were brought to Africa to be raised for food. Some escaped and their populations have grown and expanded to new areas.

In other places where crayfish have invaded, scientists found crayfish can reduce the amount of plant life in an area. They can reduce the number of insects and other invertebrates, like spiders, that live in the water.

1. **Create** a poster or presentation that shows what might happen to crocodiles in the Okavango if crayfish invade and have a big effect on the ecosystem. Think about what crocodiles of different sizes eat. Consider how crayfish might change the prey of these crocodiles. Could these crocodiles eat crayfish? What would happen to the population of crocodiles if yearlings, juveniles, or subadults didn't survive as well? What if the crayfish could improve their survival rates?

This activity also works well as a class discussion or group project. Posters should consider how crayfish might change the diets of different age classes. Yearlings would likely be in trouble since their main prey (insects and spiders) would disappear. They probably wouldn't eat crayfish (they are too small) so their numbers would go down. That would mean fewer juveniles, subadults, and adults eventually. Students should understand that invasive species are likely to negatively change the ecosystem. However, some students might argue that crayfish may end up as more food for yearling crocodiles (and for juveniles that do eat crustaceans) and therefore not have a big negative effect. This is a solid hypothesis too and may help students see the importance of keeping ecosystems intact. You can have students suggest how they might test their ideas (for example, see if baby crocodiles can eat crayfish).