



# BOX TURTLE HEAT MAP ACTIVITY

## TIME & AUDIENCE LEVEL

- 40 - 60 minutes
- 5-12 Grade

## VOCABULARY

Plastron  
Deciduous forest  
Maritime forest  
Opportunistic omnivore  
Home range  
Territory  
Habitat fragmentation  
Radio telemetry  
GPS Coordinates  
Latitude  
Longitude  
Degrees-minutes-seconds  
Heat map

## MATERIALS

Activity Worksheets:

- Eastern Box Turtle Heat Map
- Box Turtle Coordinates & Code Table
- Comparing Heat Maps
- Answer Key, optional

Pencil or pen

Colored pencils, crayons, or markers

## SUMMARY

Where an animal spends its time in a habitat is called its home range. Understanding home ranges can help biologists make important conservation decisions. The Georgia Sea Turtle Center studies the home ranges of several eastern box turtles, a native turtle species that spends its time in the maritime forest. In this activity, you will learn more about one turtle's home range by graphing where the turtle has been found and turning your graph into a heat map.

## OBJECTIVES

- Learn what box turtles like to eat and where they live
- Understand what a home range is and why it is important
- Describe what GPS coordinates are
- Plot coordinates on a graph
- Create a heat map
- Discover some threats to box turtles relating to habitat fragmentation
- Think of ways you can help turtles in your daily life

## BACKGROUND INFORMATION

The eastern box turtle (*Terrapene carolina*) gets its name from the hinge on its **plastron**, or bottom shell, that allows it to close up completely within its shell. Their preferred habitat is the deciduous forest, characterized by a little moisture, shrubs, and tall leafy trees that provide cover. A **deciduous forest** is one in which the leaves fall off trees each winter. The box turtles that live on Jekyll Island, Georgia, live in a forest similar to a deciduous forest, but because it is near the ocean it is better classified as a **maritime forest**. As **opportunistic omnivores**, box turtles will eat just about anything they can find in their habitat, including plants, fruits, insects, worms, fungi, and even carrion.

Each box turtle has an extremely defined **home range**, which is a specific segment of habitat in which an animal lives. This is different than a **territory** because box turtles do not usually defend their home range against intruders. Box turtle home ranges can be in close association with one another, and they often overlap. When removed from their home range, box turtles attempt to make their way back almost immediately.



### CRITICAL THINKING QUESTIONS

- 1) Do eastern box turtles live in your area? If you aren't sure, try looking up a box turtle range map online.
- 2) Do other types (species) of turtles live in your area?
- 3) What are some ways you could help box turtles or other turtles in your daily life?
- 4) Do you know the latitude and longitude of where you live? If not, try going online to [www.latlong.net](http://www.latlong.net) and enter your address to find out.
- 5) If you mapped your own home range, what would it look like? Where do you get your food from? Where do you sleep, exercise, play, hike, or go to school?
- 6) If you turned your own home range into a heat map, which areas would be visited most often?
- 7) What parts of your home range overlap with the home ranges of other animals? How can you help with their conservation?

Box turtles have strong homing instincts and familiarize themselves with landmarks, food and shelter within their home range. A box turtle's home range can extend up to 12 acres, or nine football fields. While a large home range might be beneficial, it also relates to the biggest threat that box turtles face. **Habitat fragmentation** (the breaking up of habitat due to houses, roads, and all other kinds of human development), means that box turtles with large home ranges are at higher risk of being injured by cars, pets, and other human-related activities. Even a box turtle with a small home range could be significantly impacted by habitat fragmentation.

The Georgia Sea Turtle Center's (GSTC) Research Department is interested in learning more about the home ranges of Jekyll Island's eastern box turtles. To study these animals, we must track the turtles' movements. This is done through **radio telemetry**. Each box turtle in our study receives a radio transmitter that emits a specific radio frequency. Using a receiver and antenna, our researchers "tune in" to each box turtle's specific frequency, just like you would tune in to your favorite radio station in the car. Instead of music, the box turtle's frequency emits beeping sounds. The louder the sound, the closer the turtle. By playing a game of hot-and-cold, our researchers hone in on the box turtle until they have found it.

Once the researcher finds a box turtle, they collect data like the turtle's **GPS (Global Positioning System) coordinates**. These coordinates are made up of the location's **latitude** and **longitude**. Latitude tells you how far north or south of the equator you are; longitude tells you how far east or west you are from the Prime Meridian. A negative latitude value means you are in the southern hemisphere; a negative longitude value indicates you are in the western hemisphere.

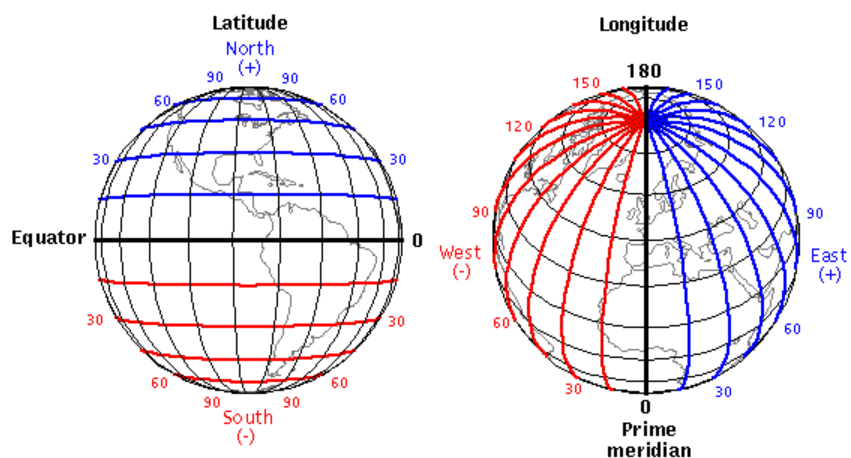


Image: 65°N 95°W Brand & CO

One method to record GPS coordinates is called **degrees- minutes- seconds (DMS)**. In this format the degrees are noted by the degree symbol ( $^{\circ}$ ), minutes are marked by an apostrophe ( $'$ ) and the abbreviation for seconds is a single quotation mark ( $''$ ). It is important when using this format to note which hemisphere (North/South/East/West) you are in. For example, a GPS coordinate on Jekyll Island, GA can be written as 31° 04' 07" N, 81° 24' 48" W.

## GEORGIA STANDARDS OF EXCELLENCE

MGSE.5.G.1 - Define a coordinate system

MGSE.5.G.2 - Represent real world and mathematical problems by graphing points

MGSE.7.G.6 - Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

SZ5.a - Ask questions and define problems identifying the cause and effect of human activities on the biodiversity of organisms.

SZ5.b - Design a solution to preserve species diversity in natural and captive environments with regard to conservation, habitat restoration, breeding programs and management of genetic diversity at local and global levels.



### CONTACT INFORMATION

214 Stable Road  
Jekyll Island, GA 31527  
(912) 635-4141  
[gstc.jekyllisland.com](http://gstc.jekyllisland.com)

For this activity, you will use a grid to plot GPS coordinates with a horizontal x-axis and a vertical y-axis. The coordinates used are from one of the box turtles, Moonpie, in the GSTC's radio-telemetry study. Once the locations are added to the graph it can then be turned into a **heat map** to visualize data using colors. In our case, the colors will represent how often Moonpie was found in parts of her home range.

Understanding a box turtle's home range and heat map is an important tool to help biologists make decisions like where to build new structures, where education might be helpful, or what areas need protection.

### SET UP

Print out the "Box Turtle Heat Map Activity," "Box Turtle Coordinate Table & Code Table," and "Comparing Heat Maps" (Pages 5-7 of this activity guide). Gather your writing and coloring utensils.

### INTRODUCTION

Get familiar with the Box Turtle Heat Map graph on Page 5. The x-axis on the bottom of the page (with numbers -23 to -34) represents the longitude at which Moonpie was found. Because Jekyll Island, Georgia, is in the Western Hemisphere, the longitude coordinates are in negative values, so the highest values (i.e., values closest to 0) begin in the bottom right-hand corner of the graph. That is also where the y-axis begins, marked by numbers 3 to 30. That axis represents the latitude at which Moonpie was located.

You will notice there are also letters across the top of the graph and numbers on the left-hand vertical axis. The vertical axis on this side of the page (marked by numbers 1 to 14), and the horizontal axis at the top of the page (lettered A through F) represent an area of the chart. These areas are outlined by the bold black lines.

### ACTIVITY PROCEDURE

*Plot the Coordinates on the Box Turtle Heat Map*

1. Find the Coordinate Table on Page 6. Begin by locating the first coordinate in the table, (-33, 17). To plot this point, find where -33 is on the x-axis of the Eastern Box Turtle Heat Map on Page 5. Then find where 17 is on the y-axis. Follow each of those lines until they meet. Draw a small circle where the two lines intersect.
2. To the left of the circle you just drew, write down the number of times the turtle was found in that location. This information is listed next to the coordinate in the Coordinate Table. For the first point (-33, 17) that number is 1.
3. Repeat Steps #1-2 for each set of coordinates.



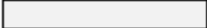


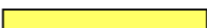
*Moonpie in 2015 with her radio transmitter on top of the shell. We paint the transmitter to match the shell for camouflage.*

### Fill in the Code Table

- Find the upper left-hand corner of your graph where the letter A and number 1 meet. The boxes that lie within the bold lines under the letter A and to the right of the number 1 are within the code A1. You will notice that the whole map is coded this way so that each box outlined in bold has a unique letter-number combination. Did any of the coordinates you plotted in Steps #1-3 fall within the box for A1? If the answer is yes, add together how many times the box turtle was found within the code A1 (in other words, add together the numbers you wrote down next to the points in Step #2). Write down this number in the Code Table on Page 6. If there were no coordinates that you plotted within the code A1, then write down 0 in the Code Table in the space next to A1.
- Repeat Step #4 for each code (A2, A3...B1, B2, etc.).

### Transform your Graph into a Heat Map

- To turn your graph into a heat map, you will color the boxes in each code based on the total number of times the box turtle was found in the code. To do this, you need to locate the legend underneath the heat map graph.
- In the legend, you will notice that there are already categories for the number of times a turtle was found in an area. To the right of those categories are boxes. Choose a different color for each category and fill in the box. We suggest using cooler colors (like blue) for low numbers and warmer colors (like yellow) for high numbers. Our example is to the right, but you can choose your own colors if you prefer.
- Once you have filled out your legend, you are ready to color your heat map. Refer to the Code Table and find how many times a turtle was found in the code A1. Use your legend to find out which color matches the category in which the number falls. In our example above, if the turtle was found in A1 two times, then it falls in the category for 1-6; the matching color is light blue. Use this color to fill in the A1 box on the heat map.
- Repeat Step #8 for each code until your whole map is colored.

Legend (fill out in Step #7)	
# Times in the Area	Color of the Area
0	
1-6	
7-12	
13+	

### Compare Heat Maps in Part II of the Activity

- Compare the heat map you created to Moonpie's real heat map on Page 7 of the guide, then answer the questions that follow.
- If you want to be sure your points, heat map, and answers are correct, refer to the Answer Key at the end of this activity on Pages 9-11.

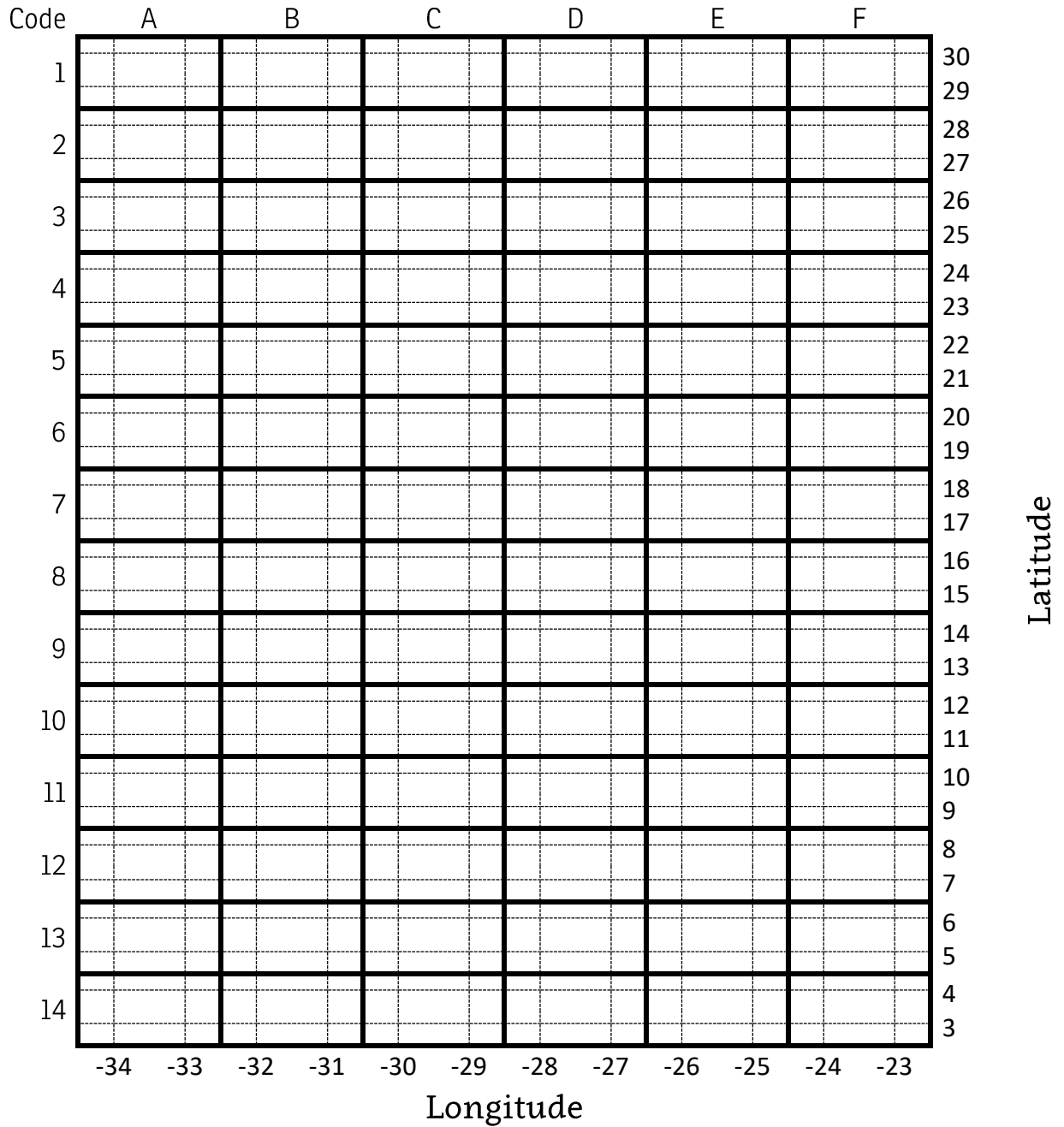
### WRAP UP & CONSERVATION MESSAGE

Because many box turtles (and other turtle species) live in fragmented habitats, we need to try to help them whenever possible. As a driver or a passenger in a car, you can help turtles survive by watching the road carefully for small animals crossing. Turtles cross roads often in the spring and summer when they are looking for mates and nesting. Additionally, if you live in an area where box turtles might also live, then you can help them by carefully checking your lawn before mowing and watch that your pets do not find and harm box turtles in your yard. Finally, if you ever come across a box turtle in nature, remember that it is a wild animal with a very specific home range! It is best to admire the turtle from a distance and let it remain in its home.



## Part I

### Eastern Box Turtle Heat Map Activity



Legend (fill out in Step #7)	
# Times in the Area	Color of the Area
0	<input type="text"/>
1-6	<input type="text"/>
7-12	<input type="text"/>
13+	<input type="text"/>

## Part I

### Box Turtle Coordinate Table & Code Table

Coordinate Table

Coordinates	# Times Seen at those Coordinates
(-33, 17)	1
(-26, 15)	2
(-28, 23)	1
(-29, 16)	1
(-24, 13)	10
(-25, 6)	1
(-29, 24)	4
(-24, 14)	7
(-25, 14)	5
(-29, 20)	1
(-30, 26)	1
(-25, 10)	1
(-30, 25)	16
(-24, 15)	4
(-25, 12)	4
(-29, 21)	1
(-25, 11)	6
(-29, 22)	3
(-25, 18)	1
(-26, 10)	2
(-30, 7)	1
(-26, 11)	1
(-28, 18)	4
(-23, 13)	3
(-29, 18)	1
(-29, 14)	1
(-30, 24)	3
(-29, 25)	1
(-28, 24)	1
(-25, 13)	2
(-25, 8)	1

Code Table

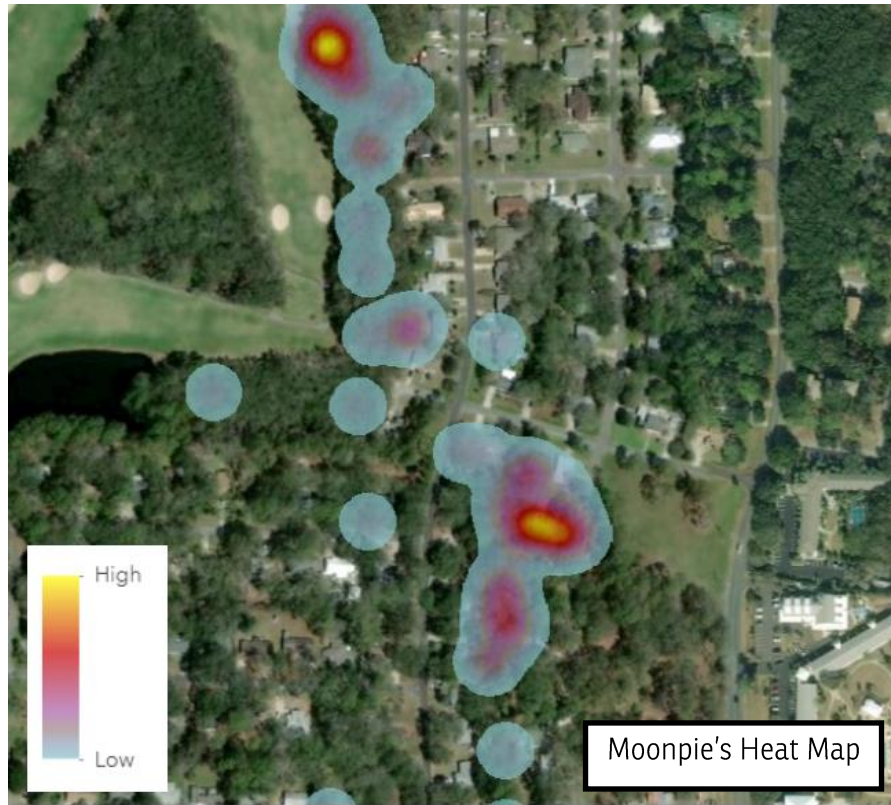
Code	#Times in that Code	Code	# Times in that Code	Code	# Times in that Code
A1		C1		E1	
A2		C2		E2	
A3		C3		E3	
A4		C4		E4	
A5		C5		E5	
A6		C6		E6	
A7		C7		E7	
A8		C8		E8	
A9		C9		E9	
A10		C10		E10	
A11		C11		E11	
A12		C12		E12	
A13		C13		E13	
A14		C14		E14	
B1		D1		F1	
B2		D2		F2	
B3		D3		F3	
B4		D4		F4	
B5		D5		F5	
B6		D6		F6	
B7		D7		F7	
B8		D8		F8	
B9		D9		F9	
B10		D10		F10	
B11		D11		F11	
B12		D12		F12	
B13		D13		F13	
B14		D14		F14	



## Part II

### Comparing Heat Maps

Because the coordinates used in this activity were less detailed versions of Moonpie's real-life coordinates, we can compare your heat map to this turtle's real heat map. Take a few moments to compare the heat map you created with Moonpie's real heat map and then answer the questions below.



1. Can you guess why Moonpie might like the two yellow places on her heat map?
2. Is Moonpie's habitat fragmented? If yes, can you tell what things are within and around her habitat?
3. What are some of the human-related threats you see in Moonpie's home range?
4. If you lived in the neighborhood next to Moonpie's home range, how could you help reduce the threats that she faces?

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ANSWER KEY

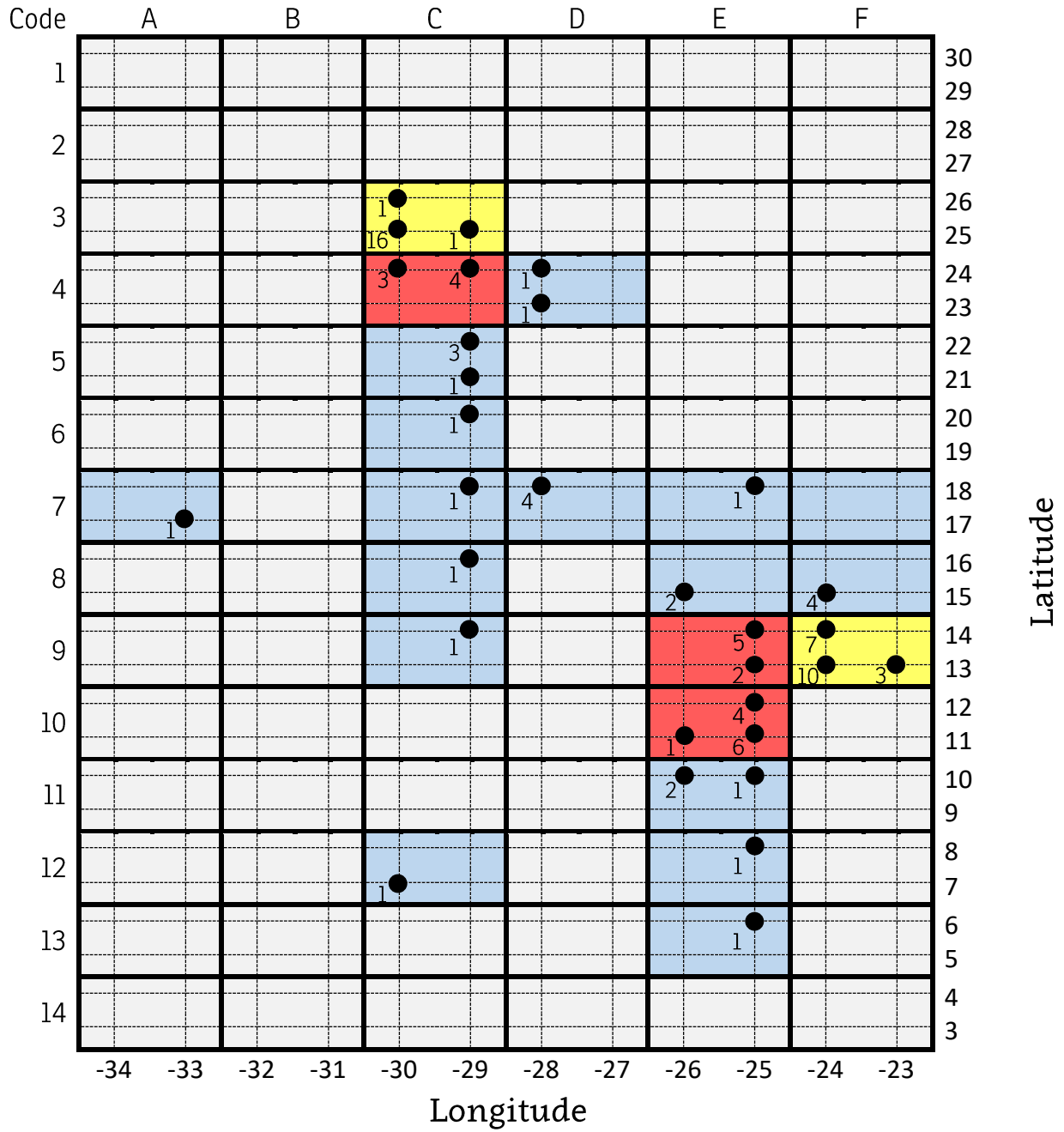
PAST HERE

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# Answer Key

## Part I – Eastern Box Turtle Heat Map



Legend (fill out in Step #7)	
# Times in the Area	Color of the Area
0	
1-6	
7-12	
13+	

## Answer Key

### Part I – Box Turtle Coordinate Table & Code Table

Coordinate Table

Coordinates	# Times Seen at those Coordinates
(-25, 8)	1
(-26, 15)	2
(-28, 23)	1
(-29, 16)	1
(-24, 13)	10
(-25, 6)	1
(-29, 24)	4
(-24, 14)	7
(-25, 14)	5
(-29, 20)	1
(-30, 26)	1
(-25, 10)	1
(-30, 25)	16
(-24, 15)	4
(-25, 12)	4
(-29, 21)	1
(-25, 11)	6
(-29, 22)	3
(-25, 18)	1
(-26, 10)	2
(-30, 7)	1
(-26, 11)	1
(-28, 18)	4
(-23, 13)	3
(-29, 18)	1
(-29, 14)	1
(-30, 24)	3
(-29, 25)	1
(-28, 24)	1
(-25, 13)	2
(-33, 17)	1

Code Table

Code	#Times in that Code	Code	# Times in that Code	Code	# Times in that Code
A1	0	C1	0	E1	0
A2	0	C2	0	E2	0
A3	0	C3	18	E3	0
A4	0	C4	7	E4	0
A5	0	C5	4	E5	0
A6	0	C6	1	E6	0
A7	1	C7	1	E7	1
A8	0	C8	1	E8	2
A9	0	C9	1	E9	7
A10	0	C10	0	E10	11
A11	0	C11	0	E11	3
A12	0	C12	1	E12	1
A13	0	C13	0	E13	1
A14	0	C14	0	E14	0
B1	0	D1	0	F1	0
B2	0	D2	0	F2	0
B3	0	D3	0	F3	0
B4	0	D4	2	F4	0
B5	0	D5	0	F5	0
B6	0	D6	0	F6	0
B7	0	D7	4	F7	0
B8	0	D8	0	F8	4
B9	0	D9	0	F9	20
B10	0	D10	0	F10	0
B11	0	D11	0	F11	0
B12	0	D12	0	F12	0
B13	0	D13	0	F13	0
B14	0	D14	0	F14	0

## Answer Key

### Part II – Comparing Heat Maps

1. Can you guess why Moonpie might like the two yellow places on her heat map?  
It is hard to tell, but it looks like those two yellow areas on the heat map are in the middle of an area covered by trees. This would provide Moonpie with cover from predators and make it less likely that people will find her. There is also more food in a forest for a box turtle; they eat things like insects, berries, plants, and mushrooms.
2. Is Moonpie's habitat fragmented? If yes, can you tell what things are within and around her habitat?  
Yes, Moonpie's habitat is fragmented. There is a golf course to the left (west) of where Moonpie likes to spend time. The golf course has sand traps, a pond, fairways (short grass) and forested patches. Most of the area to the right of Moonpie's home range is a residential neighborhood. This means there are roads, homes, and yards in that area.
3. What are some of the human-related threats you see in Moonpie's home range?
  - a. The roads fragmenting Moonpie's home range means she is at risk of being hit by a car.
  - b. People mowing their lawns might not see Moonpie and injure her with a lawnmower.
  - c. People using toxic pesticides, insecticides, and other chemicals in their yards could accidentally poison Moonpie.
  - d. Pets like dogs or cats might have an instinct to hunt if they see Moonpie in the yard and injure her.
  - e. People might think Moonpie would make a good pet and try to take her home.
4. If you lived in the neighborhood next to Moonpie's home range, how could you help reduce the threats that she faces?
  - a. Follow posted speed limits on the road and watch out for any small animals crossing the road. If you found Moonpie or another turtle crossing the road and it was safe, you could help by moving Moonpie to the other side of the road in the same direction she was moving.
  - b. Mowing your lawn often will keep the grass short enough that you can see Moonpie before accidentally hitting her. If the grass you are mowing is long, take extra care to look for turtles and other small animals that might be hiding in it.
  - c. Try to find natural alternatives to chemicals you use in your yard and use them sparingly to avoid poisoning Moonpie and other wildlife.
  - d. Keep an eye on your pets when they are outside so that they do not injure Moonpie or other small animals.
  - e. Leave all box turtles and animals in the wild when you find them. Admire them from a distance, take photos, and make memories of your special encounter!