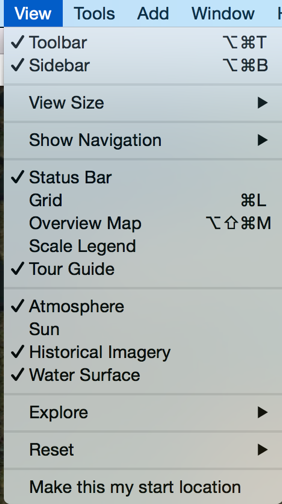
**Let’s Explore!** 

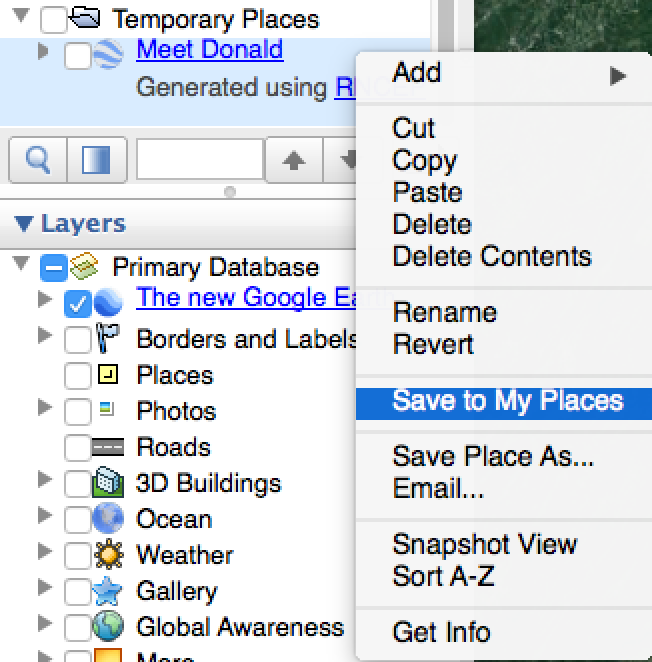
Welcome to Hawk Mountain’s lesson on the **movement ecology** of black vultures! During this lesson, you will have the opportunity to meet several black vultures by looking at a data set that shows their movements throughout different times of the year. In order to better understand the movement patterns of this primarily non-migratory raptor, you will learn how to use Google Earth, a tool that accesses satellite imagery and turns the planet into a 3-D visual right before your eyes. By using Google Earth, we are essentially viewing a virtual globe that incorporates many features we would otherwise be unable to investigate, such as differences in elevation, road networks, buildings, habitat divisions, etc. During this lesson, we will ask you to use your critical thinking skills and make your own **inferences** about *why, when, where, and how* these birds are moving (or not moving). Then you will be asked to summarize what you have learned by reflecting on why vultures matter!

*Things to keep in mind*

1. Whenever you see a word in **bold,** you can find its definition on the vocabulary sheet. There are already two words for you to look up from the paragraph above. Reference the vocabulary sheet as many times as needed throughout the lesson.
2. Making inferences requires that you make an educated guess based on available evidence. However, not every question has *one* answer, and each student may arrive at a different conclusion.
3. If you have trouble viewing a landscape feature in Google Earth, you can go to the view bar and select “historical imagery” (shown below) which will provide an older picture of the landscape that may be easier to see. Just remember to un-check this option once you are done visiting that particular feature.



**Before beginning:** Open up each bird’s Google Earth files. They will automatically open up in a file titled *Temporary Places*. Right click and save to *My Places.*

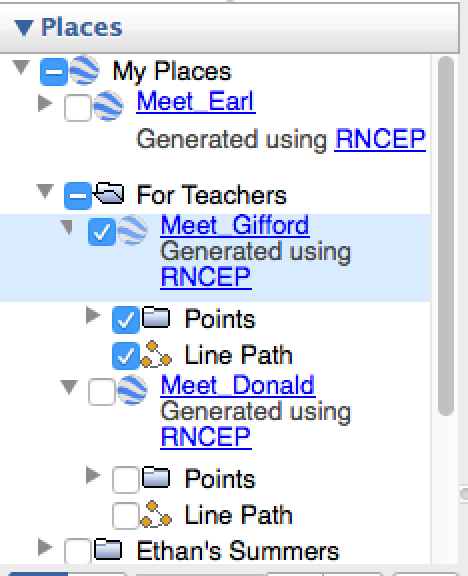


This way, all you need to do is check the box next to the bird you are investigating when you are ready.

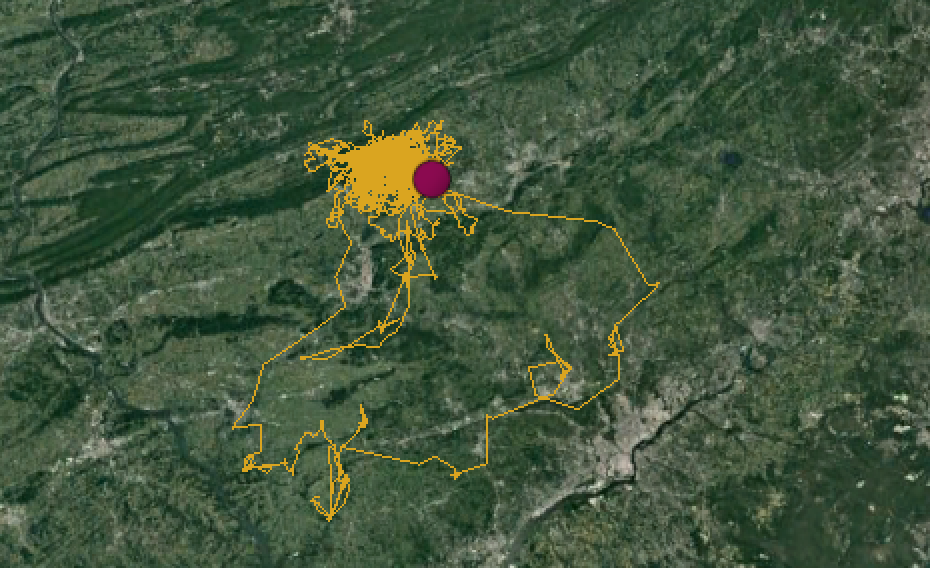
1. **Meet Gifford**

*For your first activity, you will be investigating the movements of an adult black vulture named Gifford from September 2015 to April 2016. The following prompts and questions will help you become familiar with Google Earth, and will also introduce you to some of the ways in which tracking devices provide information about where a bird chooses to spend its time and why.*

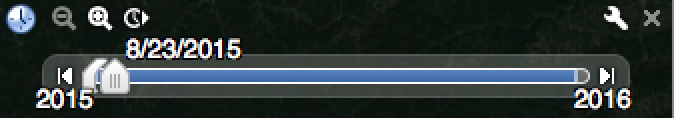
Open up the file titled *Meet Gifford*. Your side bar window should look like this (order of individuals may be different on your screen)

****

And your map should look like this:



Go to the time bar in the top right section of your map, and take notice of both the crescent-shaped icon and the house-shaped icon. By moving these two icons you may scroll through the data set and view certain locations (the magenta-colored dots) within certain date ranges. The date can be viewed above the bar at any given time, and the start date and end date are shown on either end. After becoming familiar with this bar, set it up to match the image below and press the play button which can be found on the far right of the top icons. To pause the animation, simply click on the house-shaped button.



1a) Watch this animation several times through. *During what time of year does Gifford seem to move away from his “normal” area? Be specific.*

Tip: There are 2 ways to view particular months: by moving *both* the crescent-shaped icon and the house-shaped icon together, you can look at data points from certain months, *or* you can un-check the boxes next to months you are not interested in viewing and you will be left with data for your months of interest.

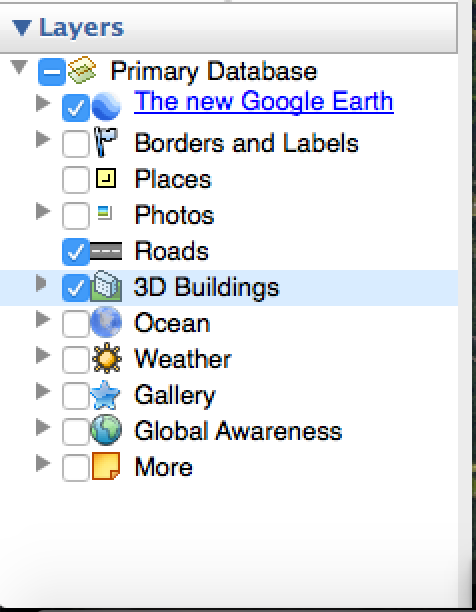
A**nswer here:**

1b) *After investigating his movement patterns, make an inference as to why Gifford may have chosen to travel further during this time of year. It will be helpful to refer back to the black vulture natural history handout for this information. Use words from your vocabulary sheet when possible.*

A**nswer here:**

1c) *List three landscape and/or man-made features that you notice along Gifford’s exploration track.*

Tip: You may ask Google Earth to show you roads, buildings or places at any point during this lesson by checking items of interest in the “Layers” bar to the left of the screen.



A**nswer here:**

1.

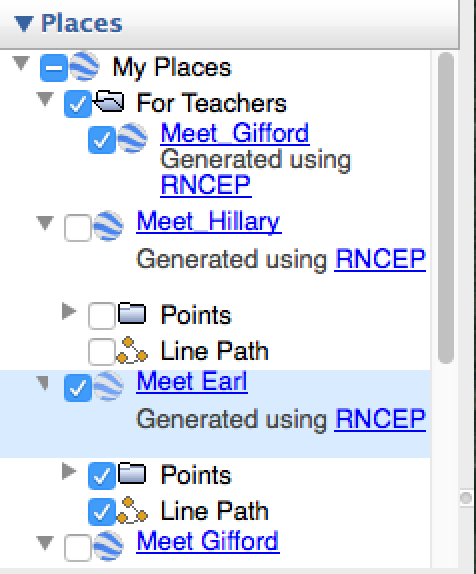
2.

3.

1. **Meet Earl**

*For this next section, you will have the opportunity to learn about* ***roosting sites*** *through the movements of an adult black vulture named Earl during the two months of December 2015 and January 2016. Open the file titled “Meet Earl,” whose data points will be shown in blue and red. For this track, blue data points are night-time locations, while red data points are day-time locations.*

When you open Earl’s file your side bar window should look like this:



2a) As you did before, move the icons, press the “play” button on the time bar, and watch the animation. Then, zoom in to Earl’s night-time roosting locations. *Which type of habitat does Earl choose to sleep in most often?* *Make an inference as to why this may be a good location for a black vulture to spend the night. Don’t forget to reference your natural history handout if you need help.*

Tip:Keep in mind that a cluster of points is most likely to show a “roosting site.” One blue dot by itself may just show a location taken while the bird was flying at night.

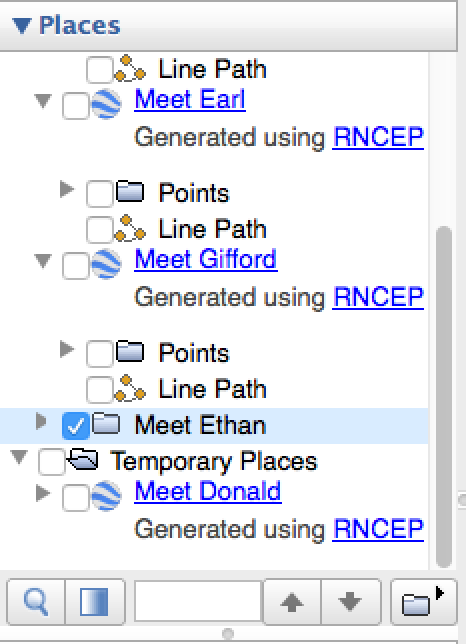
2b) *Why would it make sense for a black vulture to spend the night near agricultural areas, open fields, or bodies of water?*

A**nswer here:**

1. **Meet Ethan**

*Ethan is an example of a bird with a large data set: Hawk Mountain scientists have been collecting information from him for 3 years. Scientists often like to conduct “long-term” studies in order to answer certain questions. This is necessary because the longer an organism is studied, the more we can learn about its annual cycle. In the following section you will have the opportunity to see where Ethan (an adult male) spent his time in the Summers of 2014, 2015, and 2016.*

When you open Earl’s file your side bar window should look like this:



Play the animationto see where Ethan spent his summers for those three years. 2014 will be shown in purple, 2015 in green, and 2016 in blue. Keep in mind that no data will show during Fall, Winter, and Spring, but only so that you can more easily focus on his summers. Ethan did still exist during the rest of the year!

3a) *Explain how Ethan’s movements relate to the concept of* ***site fidelity.***

A**nswer here:**

3b) *Zoom in and examine this parcel of land. What landscape and man-made features may have contributed to this site fidelity? In other words, what might Ethan have liked about the area?*

A**nswer here:**

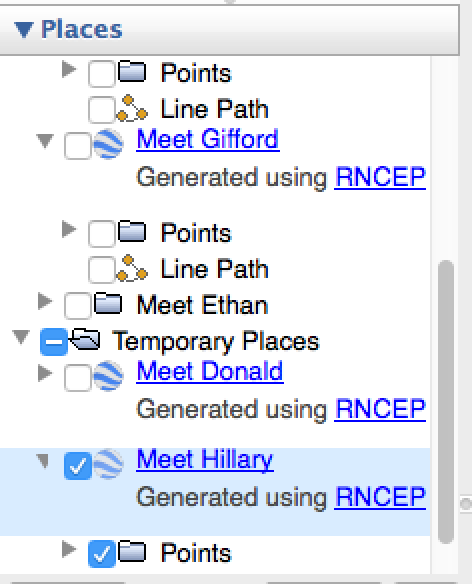
3c) *Is it likely that human land-use could change Ethan’s desire to return to this summer site? If so, which types? If not, justify your answer. Refer back to your natural history handout handout if you need help:*

A**nswer here:**

**Meet Hillary**

*Hillary (adult) is a great example of a bird with some interesting movement patterns and site preferences. As you explore her track keep an eye out for new discoveries! Colors of data points will coordinate with night and day as seen in Ethan’s questions earlier (blue = night location, red = day location).*

4a) Open the file titled *Meet Hillary.* When you open her file your side bar window should look like this:



Investigate her movements. *List at least three man-made structures that Hillary spends time on or near. What kind of interactions do you think Hillary has with humans?*

Tip: Remember that you can ask Google Earth to show you the labels of buildings and places

A**nswer here:**

4b) *How do Hillary’s site preferences differ from another bird you have investigated in this lesson?*

A**nswer here:**

4c) *Make an inference as to what behavior may be responsible for Hillary’s movement pattern between September 14th and September 21st.*

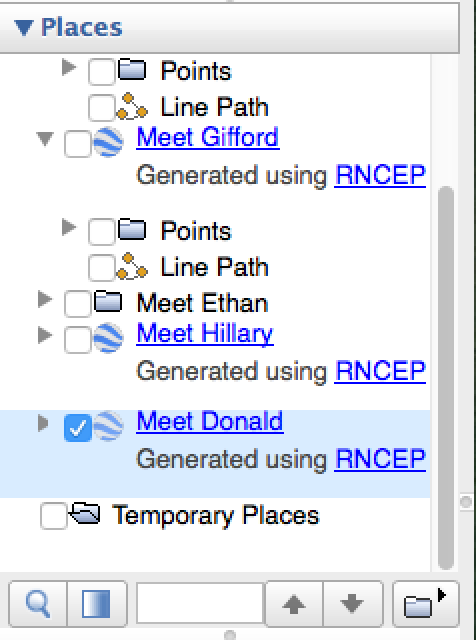
Tip: You may need to adjust your time bar icons to look at specific dates.

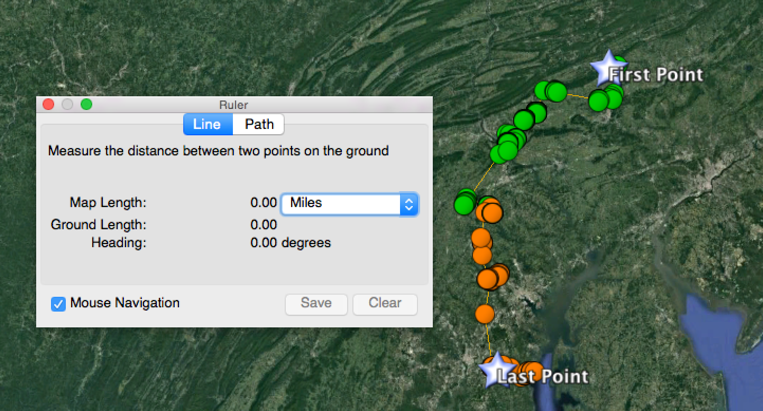
A**nswer here:**

1. **Meet Donald**

*Donald (who is actually an adult female) is the only tagged eastern black vulture in Hawk Mountain’s data set that demonstrates migration: Donald is called a* ***short-distance migrant.*** *Explore Donald’s track, keeping in mind that Summer will be shown in green and Fall will be shown in orange. Note how Donald’s movements differ from those of the other birds you have investigated so far in this lesson.*

4a) When you open Donald’s file your side bar window should look like this:





5a) Click on the ruler icon in Google Earth that is located in between the planet and envelope icons across the top of your screen. You will see a window pop up (as shown below), and your mouse will turn into a white square. Zoom into Donald’s “first point,” making sure to get as close as possible to the actual location. Once you click, you will be see a yellow line appear that will allow you to measure the distance between two points. You will have the ability to maneuver up and down the screen with either your keyboard arrows or your mouse as long as you check “mouse navigation” as shown above. *Measure the distance between the first and last points of Donald’s migration, and write down the number in miles. Then, convert to kilometers (*the official scientist’s metric!) *using the following formula:* ***1 mile = 1.61km.***

A**nswer here:**

5b) *What type of unique habitat did Donald visit around September 4th/5th and August 21st? Make an inference as to why these may have been appealing habitats for Donald to visit based on what you know about black vulture natural history.*

A**nswer here:**

5c) *Explore Donald’s entire track. Look at where Donald was tagged (the beginning of his track), and compare this location to where he ended up in Maryland. Explain some of the the differences you observe in the landscape along his migration. Then, using what you now know about movement ecology, make an inference as to why Donald may have moved as far as he did:*

A**nswer here:**

5d) *Find and describe two landscape and/or man-made features along Donald’s migration that you find interesting. Then, make an inference as to how these features may have a positive or negative influence on the daily lives of black vultures as they move through the landscape. If you were a scientists studying and protecting black vultures, how might this information help you?*

A**nswer here:**

***Knowledge Application***

1. *Peruse the data of several birds and look for how they seem to position themselves in relation to roads. Answer the following questions:* 
   1. *Explain the relationship you notice between black vultures and roads.*
   2. *What are two ways in which roads might affect vultures?*

1.

2.

1. *How would you summarize the movement ecology of the black vultures you met during this lesson? In other words, explain in your own words how these black vultures moved, why they moved, and where they moved to.* *Use examples from the lesson plan, as well as details from the natural history handout in your answer.*
2. *Sample size refers to how many samples (in this case number of vultures) you have within a particular study, and when scientists are trying to answer a question, larger sample sizes (more tagged vultures) provide more reliable results. Why do you think that is? For example, if you designed a survey to discover whether teenagers prefer pizza or spinach more, do you think it would be better to survey 4 teenagers or 100? Why?*
3. Take a moment and consider how people in your life (family, friends, classmates, teachers, etc.) feel about vultures. Are they well-liked? Disliked? *How do our feelings about an animal impact their populations and/or ability to survive?*

Tip: Think about Hillary, and how much time she spent near man-made structures and cities. How might people’s attitudes impact her?

***Conclusion***

Read *The Importance of Vultures.* Then, on a separate piece of paper, take what you have learned in this lesson and answer one of the following questions:

1) The tracks that you viewed in this lesson are examples of **data visualization,** which is a tool that scientists use to help people understand the meaning of data through visual examples (such as a map). *Why is it important to present data in different forms? For example, why would we ask you to explore the movement ecology of vultures using Google Earth instead of giving you a table of numbers? How do data visualizations help connect people to nature?*

2) *What types of challenges might scientists and/or conservationists face when trying to protect a species? What is a possible solution that could help with one of these challenges?*

3) *Is it anyone’s responsibility to protect vultures? If so, whose? How might the world be a different place if vultures did not exist?*

4) *If you were asked to write a study that would provide new information about black vulture movement ecology, what primary question would you ask and why? How would your study contribute valuable information about black vultures?*