Climate and Habitat[1]

Objectives:
By the end of this activity, students will be able to:

1. List key factors that contribute to regional climate.
2. Describe the links among precipitation, vegetation and habitat, using maps as supporting evidence.
3. Describe the relationships among climate, habitat, vegetation types and wildlife species.
4. Hypothesize how changing regional climates may affect wildlife.

Content areas:
Science and social studies

NC Essential Standards:
6.L.2.3., 7.E.1.4, 8.E.1.1, 8.L.3.1

Common core:
R1, R3, R8, W1

NGSS:
MS-ESS2.C, MS-ESS2.D, MS_LS2.A

Materials:

- ☐ County map (one for each group)
- ☐ Statewide vegetation map (in color, one for each group)
- ☐ Statewide wildlife range maps (one for each group)

Either:

- ☐ Statewide temperature and precipitation maps (one set per group) OR
- ☐ Temperature and precipitation data (one copy per group)

- ☐ Colored pencils (one set per group)

Activity Time:
One 45-minute class period

Setting:
Classroom

Background:

Habitat refers to the area inhabited by a particular species, and is defined by abiotic factors (e.g., temperature, rainfall, light, and soil) and biotic factors (e.g., plant species, food, predators). Habitat is influenced by **regional climate**, or the typical weather patterns for a region. Regional climate controls many abiotic and biotic components of habitat. The North Carolina mountains have a different regional climate than the North Carolina coast. Regional climate is mainly influenced by elevation, latitude, and proximity to a large body of water (e.g., the ocean). In North Carolina, the biggest factor driving differences in annual temperatures is elevation. Our state has the largest elevation range of any state east of the Mississippi River. Mount Mitchell (6,684 feet) is the highest point in the Appalachian Mountains. Temperatures in the mountains are cool, and as the land slopes toward the coasts, temperatures get warmer. The topography of the mountains also affects precipitation amounts. Part of the southwestern mountains (near Lake Toxaway in Transylvania County) receives almost 230 cm (90 in) of rainfall per year on average from weather systems that come from the south. By contrast, the nearby French Broad River valley (including Asheville) is sheltered on all sides by mountains, and it receives only about 100 cm (40 in) of rain per year, on average. This large difference across a short distance (about 50 miles) is caused by **orographic lift**, which is when air is forced from low elevation to high elevation. Because the prevailing winds in this area come from the southwest, air is forced from the valleys up the sides of the ridgelines of the mountains. As the air rises, it cools quickly and forms clouds, which causes precipitation to form. The rain falls predominantly along the ridge and on the southwest side of the mountains (near Lake Toxaway) and as a result, less moisture is available on the opposite side (near Asheville) for clouds and rainfall to form. In addition, the air sinks and warms as it descends the leeward side of the mountain, which is also not favorable for precipitation formation. This is also known as a **rain shadow**. Outside of the mountains, North Carolina averages around 120 cm (45-50 in) of annual rainfall. Proximity to the ocean also affects regional climate. Other locations at the same latitude as

North Carolina are desserts (e.g., the Southwestern United States). Our proximity to the Gulf of Mexico and the Atlantic Ocean as well as the prevailing southwestern winds create humid conditions in North Carolina. The warm Gulf Stream and the Atlantic Ocean also influence temperatures along the coast. It takes a long time for the ocean to heat up and cool down in comparison to the land. As a result, the ocean temperature lags the air temperature in terms of when it is at its warmest and coolest points during the year. So, the ocean helps moderate air temperatures near the coast. This means that in the summer, the ocean works to lower the air temperature along the coast and in the winter, the ocean works to warm the air temperature at coastal locations in comparison to surrounding locations. This effect is especially prominent during winter months. Another aspect of the moderating effect is the ocean temperature does not vary as drastically as air temperature. As a result, coastal locations end up having a lower daily temperature range.[2]

An adequate habitat includes the right range of temperatures, access to fresh water, food sources, and places to hide from predators and raise young.[3] Regional climate drives long-term patterns in temperature and precipitation, which determine the type of vegetation in an area. This vegetation, in turn, influences which wildlife species can survive in a particular location. For instance, the cool and wet southwestern North Carolina mountains support certain species like the Eastern Hellbender, which require cool, fast flowing rivers to survive. The abundance of rainfall keeps those streams flowing with plenty of fresh, well-oxygenated water. The regional climate also provides excellent conditions for plants like the Catawba Rhododendron that serves as cover for birds like the grouse and provides food for hummingbirds and butterflies[4]. The coastal swamplands are generally warmer than the mountains and although they receive less rainfall, the soils are better at holding water. The warm temperatures and saturated soils support species like the bald cypress. Cypress seeds provide food to wild turkey, wood ducks, evening grosbeak, and squirrels. Also, their large canopies provide nesting sites for bald eagles and ospreys. Their root systems provide breeding sites for catfish and several types of frogs, toads, and salamanders[5].

Changes in regional climate will change regional vegetation patterns creating habitats that are more suitable for some species than for others. In recent years, a rise in global temperatures has occurred, which has directly affected some regional climates. Land use and land cover changes as well as urbanization can also have an influence on regional climate – these changes can either lead to cooling or warming effects in a particular region. On average, species across the world have shifted toward the poles at a rate 16.9 meters per decade and to higher elevations at a rate of 11.0 meters per decade, as they follow the cooler temperatures and associated vegetation.[6] Rainfall patterns have also been shifting over the past few decades, with some areas like the southwestern United States experiencing more frequent droughts, and other places such as the Southeast receiving more frequent heavy rainfall[7,8.] Over recent decades, temperatures in North Carolina have increased slightly, and average rainfall has been increasing very slightly.[2] Sea levels along North Carolina coasts have also risen in response to land-based ice melting in other places around the world.[9.]

The next activity will dive more deeply into climate change and its potential impacts on wildlife, but this activity prepares students to think about the connections between climate, wildlife, and habitat and hypothesize how climate may impact wildlife.

Getting ready:

1. Decide whether you provide students with a data table of annual temperature and precipitation data for your state by county or whether you will provide ready-made maps. Using tables will give students good experience visualizing data on a map. However, it can be time consuming. If you are pressed for time or working with younger audiences, you may choose to use ready-made temperature and precipitation maps.

If using a table:

Note: For North Carolina, there is an example table on page 17 that will work well. You may use that one and forego these steps. The following requires some basic familiarity with Excel.

a. Visit http://www.ncdc.noaa.gov/cdo-web/search.
b. Select the following options:
    i. Weather Observation Type/Dataset: Annual Summaries
    ii. Date range: Select the previous complete year. For example, at this printing, we are in the middle of 2014, so you should select Jan-Dec 2013.
    iii. Search for: Counties
    iv. Search term: State initials (e.g., NC).
c. Click search. You should see a number of counties highlighted in your state.
d. In the left menu, add enough counties that you have a representative area of your state covered. In North Carolina, you will need about 30 counties.
e. In the upper right corner, click to view your cart. This is a free site.
f. Select Annual Climatological Summary CSV and the most recent year for the date range and click Continue.
g. Select Station Name as an option. Click the + sign by Precipitation, then select Total Precipitation. Under Air Temperature, select Monthly mean temperature and click continue.
h. Enter your e-mail address and submit your order. You should receive two e-mails shortly. The first confirms your order and the second includes a link to your dataset.
i. Click download the data. You should see 5 columns:
    i. Station ID
    ii. Station Name
    iii. Date (yyyymm)
    iv. TPCP (total precipitation in tenths of an inch: divide by 10 for inches)
    v. MMNT (monthly mean temperature in tenths of degrees F: divide by 10 for degrees F).

    Note: Some of the data from the NCDC is incomplete and you will see "-9999" in place of actual measurements. If this is the case, delete these cells and eliminate that station's data from your dataset.
j. In the next two columns, calculate the average precipitation and temperature. Each row represents one month. For the first station, select the blank in the average precipitation column associated with December for an individual station. Type in "**=AVERAGE(**" and highlight the precipitation averages for each month associated with that county and close the parentheses.
k. Copy and paste that formula down the entire column. Repeat the process for the temperature data.
l. Copy both columns and Paste Special as values to delete the formulas.
m. Delete all rows except for the ones that contain the last month in your dataset (e.g., December).
n. Use the internet to look up which county each station is in. Add another column titled "County" and enter that information into your dataset. For North Carolina, see the table on pages 18-19 for a list of stations and counties.
o. Provide students with a table with four columns. County name and Precipitation (sorted from lowest to highest and County name and Temperature (sorted from lowest to highest). See the example data table for clarification.

If you are using ready-made maps, download maps of annual temperature and precipitation from your state climate office. (See Appendix B for North Carolina Maps).

Each group will need:

- *If using data table:* colored pencils
- *If using ready-made temperature and precipitation maps*: one set of temperature and precipitation maps per group.
- Set of the following maps (See Appendix B for North Carolina Maps):
    - State county map (easily found online)
    - State vegetation map (search for your state's GAP analysis project). These should be printed in color if at all possible. Otherwise it is difficult to see the distinction between all the different vegetation types. If color copies are not possible, consider projecting the image for the class in color.
    - Wildlife range maps (available through your state's wildlife agency or GAP analysis project website).

Note: The above materials allow students to compare maps side-by-side. You may also want to have students draw precipitation and temperature layers using transparencies. For this, you will need two transparencies per student group and you should print all maps except the county map on a transparency.

Procedure:

1. Review with students key concepts from the previous lesson:
    a. Difference between weather and climate *(weather is atmospheric conditions, such as temperature, precipitation, wind, and humidity, on a given day. Weather is happening today or in the near future up to two weeks.* Climate refers to the statistical representation of the environment over time, including seasonal cycles, extreme events, and year-to-year variations, and describes trends of the weather).
    b. Weather and climate can have effects on wildlife

2. Review with students the concept that regional climate determines average temperature and rainfall in an area. Brainstorm factors that might affect regional *climate (elevation/topography, latitude, proximity to the ocean)*. Ask students to think about how climate might affect what kinds of plants and animals can live in an area. Explain to students that today's activity will help answer these questions.

3. Review the habitat concept. Explain what wildlife need to survive: water, food, shelter and space. Introduce the idea that regional climate affects wildlife survival directly by influencing temperature and rainfall and indirectly by influencing the type of vegetation in a region.

4. Have students work through the "Climate and Habitat Student Sheet" in groups. If students are fairly comfortable with maps and data, provide a table for the precipitation and temperature averages by county that students can use to make their own precipitation and temperature maps. For younger students or to save time, you can provide average annual temperature and precipitation maps. See Appendix B for these maps specific to North Carolina. If you are using transparencies, have students overlay one blank transparency over the county map to shade in precipitation regions. Then have them overlay the second transparency over the county map to put draw symbols representing temperature regions. Students can then overlay these transparencies to see how prepetition and temperature correlate.

5. When students compare the precipitation and temperature maps to the land cover map, they should answer questions in groups related to how vegetation correlates with precipitation and temperature

averages. If students are using transparencies, they can overlay their precipitation and temperature maps on top of the land cover map for this comparison.

6. When students are ready to compare these maps with the wildlife range maps, you can either give all range maps to each group or assign each group a different range map. If groups do not have access to all the range maps, have each group report out their findings to the class. Again, if students are using transparencies, they can overlay all the maps or several at a time to see how temperature, precipitation, land-cover, and wildlife ranges correlate.

Discussion and assessment

1. After students have completed the activity, discuss answers, using the following questions to guide the discussion.
    a. Why do you think some areas of the state get more rainfall than others? Are hotter than others? What impacts the temperature of different regions? *The main factors include elevation/topography, latitude, and proximity to the ocean. See background information for more details, along with the answer key to the student sheet.*
    b. How do temperature and precipitation affect wildlife? *These determine vegetation types in an area, which determines the habitat available, which dictates what wildlife can live there.*
    c. What do you think would happen if regional climate changed and some areas became warmer or colder? Had less or more rain? If precipitation were more or less intense over time (more floods and/or droughts)? *These changes would have many effects (discussed in more detail in the next activity). For now, students should grasp the concept that change in temperature and precipitation will influence the type of vegetation that can live in an area, which directly affects wildlife in terms of where they can thrive and survive.*

Extensions

1. Have students write an argument on how regional climate changes may affect wildlife.

References and Sources for More Information

---

[1] This activity was adapted from several mapping activities including "Rainfall in the Forest" from Project WILD.

[2] State Climate Office of North Carolina. (2014). NC Climate Overview. Retrieved October 27, 2014, from http://www.nc-climate.ncsu.edu/climate/ncclimate.html

[3] National Wildlife Federation. (2014). Effects on Wildlife and Habitat. Retrieved October 27, 2014, from http://www.nwf.org/Wildlife/Threats-to-Wildlife/Global-Warming/Effects-on-Wildlife-and-Habitat.aspx

[4] Spira, T. P. (2011). *Wildflowers and Plant Communities of the Southern Appalachian Mountains and Piedmont: A Naturalist's Guide to the Carolinas, Virginia, Tennessee, and Georgia: A Naturalist's Guide to the Carolinas, Virginia, Tennessee, and Georgia*. Univ of North Carolina Press.

[5] Coladonato, Milo. (1992). Taxodium distichum. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Retrieved October 27, 2014 from http://www.fs.fed.us/database/feis/.

[6] Chen, I.-C., Hill, J. K., Ohlemüller, R., Roy, D. B., & Thomas, C. D. (2011). Rapid range shifts of species associated with high levels of climate warming. *Science*, *333*(6045), 1024–6. doi:10.1126/science.1206432

[7] Walther, G., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T. J. C., … Bairlein, F. (2002). Ecological responses to recent climate change. *Nature*, *416*, 389–395.

[8] National Climate Assessment. (2014). Retrieved November 21, 2014, from http://nca2014.globalchange.gov/

[9] Climate Central. (2014). Surging Seas: Sea level rise analysis for North Carolina. Retrieved November 03, 2014, from http://sealevel.climatecentral.org/ssrf/north-carolina

Average Annual Temperature and Precipitation for Select North Carolina Counties

	ANNUAL AVERAGE PRECIPITATION (INCHES)		ANNUAL AVERAGE TEMPERATURE (^{o}F)
Greene	34.7	**Avery**	44.5
Craven	35.6	**Haywood**	52.9
Franklin	37.1	**Transylvania**	54.2
Rockingham	39.2	**McDowell**	54.8
Scotland	40.3	**Swain**	55.0
Chowan	41.0	**Macon**	55.9
Mecklenburg	41.3	**Lincoln**	56.5
Guilford	42.0	**Rockingham**	56.5
Robeson	42.4	**Cherokee**	56.6
Rowan	42.8	**Wilkes**	56.7
Bladen	43.5	**Rutherford**	57.0
Orange	44.2	**Caldwell**	57.2
Anson	45.0	**Rowan**	57.5
Wilson	45.1	**Franklin**	58.0
Hyde	45.4	**Orange**	58.2
Lenoir	45.4	**Guilford**	58.4
Hoke	46.0	**Cabarrus**	58.6
Cabarrus	47.4	**Hoke**	59.2
Carteret	47.9	**Mecklenburg**	60.0
New Hanover	50.7	**Bladen**	60.3
Wilkes	54.8	**Greene**	60.4
Caldwell	57.3	**Wilson**	60.6
Lincoln	57.4	**Chowan**	60.7
Haywood	57.8	**Anson**	60.8
Rutherford	58.5	**Scotland**	60.8
Cherokee	64.2	**Robeson**	61.1
McDowell	66.5	**Carteret**	61.2
Swain	68.4	**Hyde**	62.4
Avery	69.7	**Lenoir**	62.7
Transylvania	72.3	**New Hanover**	63.2
Macon	78.3	**Craven**	63.3

Retrieved from http://www.ncdc.noaa.gov/cdo-web/datasets. 2013 data.

Precipitation suggested groupings: 34-45 inches, 45.1-55 inches, 55.1-65 inches, 65.1-75 inches
Temperature suggested groupings: 45-50^{o}F, 50.1-55 ^{o}F, 55.1-60 ^{o}F, 60.1-65 ^{o}F

Climate Monitoring Station and County list for North Carolina

Station	County
Arcola	Warren
Aurora	Beaufort
Banner Elk	Avery
Bayboro 3 E	Pamlico
Beech Mountain	Avery
Bridewater	Burke
Burgaw	Pender
Burlington Fire Station #5	Alamance
Burnsville	Yancy
Butner Filter Plant	Granville
Canto	Madison
Carthage Water Treatment Plant	Moore
Casar	Cleveland
Catawba 5 SW	Catawba
Celo 2 S	Yancy
Charlotte Douglas International Airport	Mecklenburg
Chatham WTP	Chatham
Clayton	Johnston
Columbia AG Gum Neck	Tyrrell
Concord	Cabarrus
Conover	Alexander
Conover Oxford Shoal	Catawba
Cullowhee	Jackson
Dunn	Harnett
Edenton	Chowan
Edenton	Rockingham

Station	County
Elkin	Surry
Elkin	Yadkin
Fairfield	Hyde
Fayetteville	Cumberland
Flat Springs I E	Avery
Forest City 8 W	Rutherford
Gastonia	Gaston
Graham 2 ENE	Alamance
Grandfather Mountain	Avery
Hamlet	Richmond
Haw River 1 E	Alamance
Hickory FFA Airport	Catawba
Hot Springs	Madison
Jefferson	Ashe
King	Forsyth
Kinston	Lenoir
Kinston AG Research	Lenoir
Lake Lure	Rutherford
Lenior	Caldwell
Lexington	Davidson
Longwood	Brunswick
Louisburg	Franklin
Marshall	Madison
Mocksville	Davie
Moores Creek National Battlefield	Pender

Station	County
Morganton	Burke
Mount Airy 2	Surry
Mount Holly 4 NE	Gaston
Mount Olive	Duplin
Mount Pleasant	Cabarrus
Ocracoke	Hyde
Oxford AG	Granville
Plymouth	Washington
Raeford	Hoke
Reelsboro	Pamlico
Reidsville	Rockingham
Rhodhiss Hydro Plant	Burke
Robbinsville	Graham
Rocky Mount 6 SW	Nash
Rocky Mount 8 ESE	Edgecombe
Roxboro	Person
Rural Hall	Forsyth
Shallotte AG	Brunswick
Shelby 2 NNE	Cleveland
Shouthport 5 N	Brunswick
Siler City	Chatham
Smithfield	Johnston
Spruce Pine	Avery
Statesville 2 NNE	Iredell
Surf City	Pender
Swansquarter Ferry	Hyde

Station	County
Tapoco	Graham
Tarboro 1 S	Edgecombe
Taylorsville	Alexander
Transou	Ashe
Turnersburg	Iredell
Wallace 1 SE	Duplin
Warsaw 5E	Duplin
Washington	Beaufort
Whiteville 7 NW	Columbus
Williamston	Martin
Wilmington 7 N	New Hanover
Wilmington 7 SE	New Hanover
Wilminton International Airport	New Hanover
Wilson 3 SW	Wilson
Yadkinville 6 E	Yadkin

Climate and Habitat
Student Sheet

Name: _____

Directions:
Your teacher may provide you with state precipitation and temperature maps. If so, compare these maps and begin by answering the questions following #5.

1. Using the data table, separate the counties into four roughly equal precipitation groups. For instance, if the average precipitation ranges from 0-100 cm annually, you might split the groups into 0-25cm, 26-50cm, 51-75cm, and 76-100cm.
2. Assign a color for each group of precipitation and create a legend on the county map.
3. Using colored pencils, shade each county on the map the appropriate color.
4. You should now be able to approximate temperature regions for the state. Draw lines between different color regions shade in region according to your legend.
5. Repeat steps 1-4 with the precipitation data, but use symbols (x, o, #, -, etc.) instead of colors to signify the four categories of annual precipitation.

   Which region of the state has the lowest average temperatures? Why do you think that is?

   Which region of the state has the highest average temperatures? Why do you think that is?

   Which region of the state has the lowest average precipitation? Why do you think that is?

   Which region of the state has the highest average precipitation? Why do you think that is?

   Do you see any relationship between the temperature and precipitation regions?

6. Now compare your precipitation and temperature map (s) to the vegetation map. Answer the following questions:

   What do you notice?

   How are vegetation patterns related to temperature and precipitation?

7. Now compare the wildlife range maps to maps for temperature, precipitation, and vegetation. Answer the following questions:

   How does temperature, precipitation, and vegetation correlate with where animals live?

   Where does a hellbender live? Why do you think it lives there?

   Where does an alligator live? Why do you think it lives there?

   Where does a Northern flying squirrel live? Why do you think it lives there?

   What do you think would happen to one of these species if the average temperatures began to rise over time?

   What do you think would happen to one of these species if the average precipitation levels began to ri over time?

Climate and Habitat
Student Sheet Answer Key

Name: _____Key_____

Directions:
Your teacher may provide you with state precipitation and temperature maps. If so, compare these maps and begin by answering the questions following #5.

1. Using the data table, separate the counties into four roughly equal precipitation groups. For instance, if the average precipitation ranges from 0-100 cm annually, you might split the groups into 0-25cm, 26-50cm, 51-75cm, and 76-100cm.
2. Assign a color for each group of precipitation and create a legend on the county map.
3. Using colored pencils, shade each county on the map the appropriate color.
4. You should now be able to approximate temperature regions for the state. Draw lines between different color regions shade in region according to your legend.
5. Repeat steps 1-4 with the precipitation data, but use symbols (x, o, #, -, etc.) instead of colors to signify the four categories of annual precipitation.

Which region of the state has the lowest average temperatures? Why do you think that is?

The mountains have the lowest temperatures because the elevation is much higher than at the beach. In most cases, temperature decreases with height.

Which region of the state has the highest average temperatures? Why do you think that is?

The highest average temperatures are near the coast. Elevation is the main factor determining this, but proximity to the Atlantic Ocean and the warm Gulf Stream plays a big role, too. As explained in the background section, the ocean has a moderating effect on coastal locations. This moderating effect of the ocean tends to be more pronounced during winter (e.g. has a warming effect on coastal locations) than during summer (e.g. has a cooling effect on coastal locations). Another aspect of the moderating effect is the ocean temperature does not vary as drastically as air temperature. As a result, coastal locations have a lower daily temperature range. Taking into account all of these factors and averaging over a year, the coastal areas of NC are still warmer than inland locations.

Students will likely not see this effect on maps at this scale, but it is possible that they may bring up the notion that urban areas are warmer than suburban areas. This is known as an "urban heat island". Because urban areas have more paved surfaces and fewer trees, they are often a few degrees warmer than the adjacent areas.

Which region of the state has the lowest average precipitation? Why do you think that is?

The lowest average precipitation occurs in the French Broad river valley (in the mountains near Asheville). This is because the mountains surrounding this area create a rain shadow due to the orographic lift discussed in the background section. Most of the moisture coming through the mountains from the southwest falls on the southwest side of the ridgeline, leaving drier, descending air to enter the next valley. Elsewhere in the state where the topography is not as mountainous, the precipitation levels are fairly uniform.

Which region of the state has the highest average precipitation? Why do you think that is?

The area of highest average precipitation is in the southwestern mountains (near Lake Toxaway in Transylvania County) due to the prevailing winds coming from the southwest and the orographic lift effect (see background section). The weather systems that enter this region from the southwest run into the high ridges of the mountains so air rises and clouds form, dumping most of the moisture there.

Do you see any relationship between the temperature and precipitation regions?

Students may be able to identify some patterns. In general, higher temperatures yield more evaporation. When there is lots of water available (like at the coast), higher evaporation can yield higher rainfall. However, the wettest area in the state is also one of the coolest (southeastern NC). In this case, the precipitation has less to do with temperature and humidity and more to do with topography.

Now compare your precipitation and temperature map (s) to the vegetation map. Answer the following questions:

What do you notice?

Students should be able to see clear patterns between temperature, precipitation and vegetation.

How are vegetation patterns related to temperature and precipitation?

Some vegetation types like cooler areas and some like warmer areas. For instance, spruce fir forests thrive in the cooler mountain temperatures while Pocosin woodland and shrub lands are better suited for the climates of the coast.

8. Now compare the wildlife range maps to maps for temperature, precipitation, and vegetation. Answer the following questions:

How does temperature, precipitation, and vegetation correlate with where animals live?

They are all connected. Temperature and precipitation are linked to the type of vegetation in an area. This determines where certain types of wildlife can live.

Where does a hellbender live? Why do you think it lives there?

Only in the mountains. It likes cool temperatures and lives in the water. Cold temperatures and lots of rainfall make cool, fast flowing mountain streams, which are perfect for hellbenders. Because they are cold and fast flowing, mountain streams can hold a lot of dissolved oxygen, which the hellbenders need and breathe right through their skin. The mountains have both (cool temperatures and lots of rainfall).

Where does an American alligator live? Why do you think it lives there?

The alligator lives in freshwater near the coast. They prefer warm waters, so they are closer to the coast where temperatures are more consistently warm all year.

Where does a Northern flying squirrel live? Why do you think it lives there?

In the mountains. They have a niche (specialty) habitat in the boreal and deciduous forests of the highest NC mountains. They tend to forage around the conifers (red spruce, Fraser firs, and Eastern hemlocks) and nest in hardwood trees like yellow birch, buckeye, and sugar maple). Since many of these trees (particularly the conifers) only occur in these cool, high climates the squirrels also only live here.

What do you think would happen to one of these species if the average temperatures began to change over time?

If the temperature became warmer, it would directly affect the hellbender because it needs cool water (which holds more oxygen). Alligators may be able to expand their ranges, and they also may grow faster. Warmer temperatures may cause North Spruce Pine forests to move northward, which means that Northern flying squirrels may lose their habitat in North Carolina.

What do you think would happen to one of these species if the average precipitation levels began to change over time?

Precipitation can affect the hydrology of streams and coastal rivers and estuaries. These changes can be complex, affecting water flow volumes, water chemistry and sedimentation. If precipitation levels drop, mountain streams volumes may drop and flow slower. This may lower the dissolved oxygen levels the hellbenders need. Higher precipitation levels may be good for stream flow and dissolved oxygen, but flooding can also wash extra sediment into streambeds, affecting hellbender nests. Less fresh water coming in to an estuary system may mean that salinity rises, which would affect the alligators as they live in fresh water. Higher rainfall may mean more fresh water coming into an estuary, which would lower the salinity levels. Seasonal droughts may affect the health of the spruce-fir forest systems on which the Northern flying squirrels depend, whereas increased rainfall may mean more vegetation growth.