

Ecology Unit Final Project

Project Description. In this project, you will use ideas and modeling skills that you've learned through your exploration of Tucker Prairie to make sense of the likely impacts of climate change on an organism from another part of the world. Your project work will have four phases:

- I. Select an organism that is being affected by (or likely will be affected by) climate change. We recommend that you select one of the [nine](http://restem4.wix.com/learning-resources#!ecology-unit-final-project/c1wfv) organisms featured on <http://restem4.wix.com/learning-resources#!ecology-unit-final-project/c1wfv> (this link is accessible on the *Climate Change Learning Resources* page. If you would like to use an organism that is not on the list but you know is being affected by climate change, talk to your teacher.

- II. Conduct research on your selected organism (there are links available for the recommended organisms that highlight much of the information you will need to find). Through your research, you need to collect information about your organism's
 - Natural history and niche (What habitat does it require? How does it acquire energy? What other species does it interact with? What abiotic factors are important for its success?)
 - Status of the species (secure, threatened, endangered, etc.)
 - Ways in which climate change may be impacting the organism (or localized populations of the organism).

NOTE: The kind of information that you will be collecting about your selected organism is very similar to the information you accessed when looking at Tucker Prairie Indicator Species (e.g., Henslow's sparrow, armadillo, Meades Milkweed, etc.)

- III. Create a visual model to describe what is happening or likely will happen to this organism with ongoing climatic changes. This model will be a diagram that you create to help explain and predict how your organism may be impacted by climate change over time. Your model may be hand drawn or created using software (e.g., Powerpoint, Word, Notability, etc.)

- IV. Write an explanation of your model and include an APA reference list (in-text citations needed, as well).

Project Criteria: Your project will have two related products: a visual model and a written explanation of your model. Criteria for these two products are presented below. A sample model and written explanation, related to Henslow's sparrow in tall grass prairies, are available on the *Climate Change Learning Resources* page.

Criteria for the visual model: Your model should...

1. Show how the organism's population trend may change over time.
2. Show the key factor(s) for your organism's population. Key factors may include habitat loss, changes in reproductive seasons or growing seasons, changes in the availability of other species, competition from an invasive species, etc.
3. Show climate change-related causal influences. Climate change is predicted to alter many aspects of climate and weather such as temperature, rainfall patterns, severity of weather systems, sea levels, etc. Your model should indicate which of these influences are significant for your organism and how the influence is affecting your organism.
4. Highlight ways that your organism is connected to other species. These interactions may be related to sources of habitat, competition, predation, food sources, etc.

Criteria for the written explanation: Your explanation should...

1. Introduction that includes:
 - a. A brief description of your organism's habitat and niche.
 - b. Thesis-- Predict (claim + reasoning) what will happen to your organism over time if Earth's climate continues to change at its current rate.
2. Describe and analyze the interactions and processes represented in your model to support your thesis/prediction. Include the following:
 - a. Attention to the key factors for your organism's population and the climate change-related causal influences
 - b. Interactions between your organism and other species and how changes in one population affects the others
3. Include in-text citations and a reference list with APA citations.

Category	4	3	2	1
Thesis Statement	Thesis statement fully addresses the prompt by making a precise claim and provides controlled and thoughtful reasoning for the claim.	Thesis statement fully addresses the prompt by making a claim and provides logical reasoning for the claim.	Thesis statement fully addresses the prompt by making a claim and provides reasoning that may be too narrow, superficial, and/or vague.	Thesis statement responds partially to the prompt with a claim that is vague, incomplete, or lacks reasoning.
Description	Smoothly and thoroughly integrates specific, relevant, and accurate evidence, creating a strong foundation for the argument.	Integrates specific, relevant, and accurate evidence, creating a foundation for the argument.	Integrates limited and/or general evidence; may lack relevance and/or accuracy; creating a weak foundation for the argument.	Attempts to integrate evidence, but is insufficient in creating a foundation for the argument.
Analysis	Clearly and efficiently breaks down and elaborates on meaning and significance of each piece of evidence.	Breaks down and elaborates on meaning and significance of each piece of evidence.	Breaks down evidence but provides limited meaning and significance.	Breaks down evidence in a confusing or incomplete manner.
Synthesis	Clearly connects the evidence and analysis to the thesis to develop the implications and significance.	Connects the evidence and analysis to the thesis to develop the implications and significance.	Attempts to connect the evidence and analysis to the thesis to develop the implications and significance.	Attempts to connect the evidence and analysis to the thesis but there is little development of implications and significance.
Visual Model	Clearly shows specific, relevant, thoughtful, and accurate cause/effect relationships that predict changes in the organism's population.	Shows specific, relevant, and accurate cause/effect relationships that predict changes in the organism's population.	Attempts to show cause/effect relationships that predict changes in the organism's population, but is limited and/or general; may lack relevance and/or accuracy.	Attempts to show cause/effect relationships that predict changes in the organism's population, but is confusing or incomplete.
Communication	Language skills are superior. Demonstrates professionalism and fluency, and is engaging to the audience.	Language skills are average. Demonstrates average professionalism and fluency, and I am engaging to the audience.	Language skills are inconsistent. Attempts to be professional and fluent, but I may not consistently engage the audience.	Language skills are lacking. Demonstrates a deficiency in being professional and fluent, and I am largely disengaging to the audience.
Research	Multiple credible sources utilized throughout the piece. Correct APA format is observed.	Multiple credible sources utilized; however, strong reliance on one source throughout the piece. Mostly correct APA format is observed.	Few sources are referenced, but they are not credible or utilized throughout the piece. Incorrect APA format is observed.	Sources utilized throughout the piece are not referenced or are not credible, and poor APA format is observed.

Sample Model Explanation for the Ecology Unit Final Project

Henslow's sparrow is a secretive bird that nests in native tall grasslands such as Tucker Prairie. This species forages in the thick cover and feeds on insects. Nesting occurs in June with a small cup shaped nest on the ground placed deep within the tall stands of prairie grass. Unlike some other grassland birds, Henslow's does not adapt well to other habitats. (*Henslow's Sparrow*) High intensity agriculture such as raising corn, wheat, or soybeans has drastically reduced the amount of available native prairie resulting in a significant population decline over the past 100 years. Holloway, Mahan, Snider, and Seek (2011) estimate that today we have less than one percent of one percent of the historic prairies found within Missouri. **It is predicted that a shift from tall grass prairie to shrubby woodland due to climatic changes at Tucker Prairie would cause a decline in the Henslow's sparrow population because Henslow's sparrow depends exclusively on tall grass prairies for its habitat.**

Climate change threatens to further reduce the available habitat for Henslow's Sparrow. The historic grassland condition is shown on the left side of the model. Grasses and herbaceous plants dominate the landscape. Without regular disturbance by fire and grazing, woody species such as sumac and wild plum with deeper root access to water would invade the prairie and become the dominant type of plant. This succession from grassland to shrubby woody thickets over time is represented in the visual model by the large center arrow moving toward the right. Fire has been a documented historical part of the landscape dating back well before the frontier settlement of the area. Regular burns spreading across the prairie

landscape move against succession. The unique clay-soil layer at Tucker prairie allows grasses and herbaceous plants regular access to moisture throughout the growing season. These two elements of fire and unique soil properties are represented by the smaller arrow in the center of the model moving toward the left.

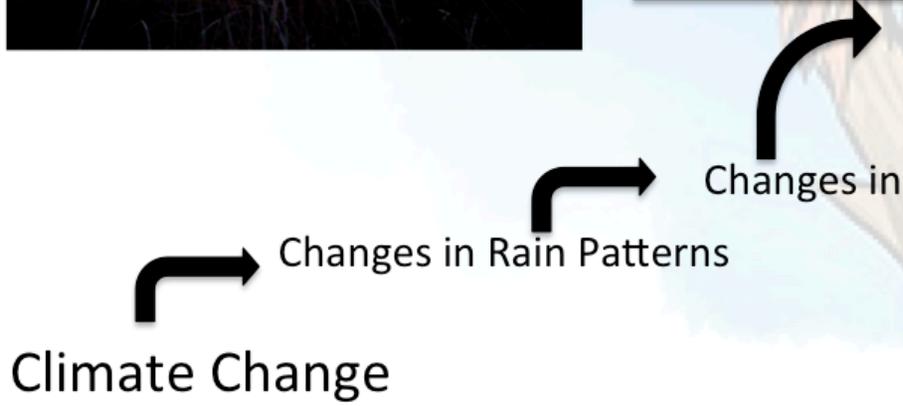
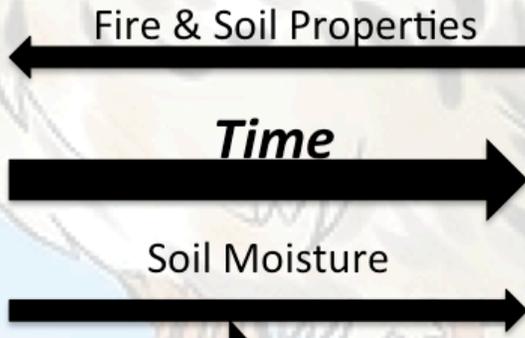
Climate change is introduced to the model at the bottom with the cascading series of changes represented by the stepwise arrows. An increase in temperature results in changes to the historic rain patterns of the area. This in turn creates changes in soil moisture. These changes in soil moisture favor the growth of woody plants whose root systems are better adapted to variable soil moisture conditions. These causal factors would result in a gradual shift in the plant community over time from grasses and herbaceous plants to woody shrub thickets.

Henslow's sparrow requires tall grasses and herbaceous plants and the insect populations found within those ecosystems (*Henslow's Sparrow*, 2014). This model predicts a decline for Henslow's as the vegetation and insect communities gradually change to a shrub thicket. The changing vegetation is not compatible with the nesting habits of the sparrow. Woody plants do not provide the types and numbers of insects that the sparrow feeds on. This creates an environment that unfortunately is not suitable for Henslow's sparrow. Individuals would be forced to move elsewhere to find suitable habitat. Due to the extreme loss of habitat already due to human development and agriculture this model predicts a bleak outlook for Henslow's sparrow.

References

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- Henslow's Sparrow. (2014, August 26). Retrieved October 13, 2015, from <http://climate.audubon.org/birds/henspa/henslows-sparrow>
- Holloway, P., Mahan, C., Snider, N., & Seek, M. (2011). *Nature unbound: The impact of ecology on Missouri and the world : Teacher Guide* (R. Knauer & K. Lohraff, Eds.). Jefferson City, Mo.: Missouri Dept. of Conservation.
- Sibley, D. (n.d.). *The Sibley guide to birds* (Second ed.).

Model for Henslow's Sparrow Population



Monarch Butterfly

http://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/index.shtml
<http://monarchwatch.org/biology/index.htm>
<http://www.learner.org/jnorth/monarch/index.html>
<http://www3.cec.org/islandora/en/item/2350-north-american-monarch-conservation-plan-en.pdf>
<http://animals.nationalgeographic.com/animals/bugs/monarch-butterfly/>
<http://monarchlab.org/>
https://en.wikipedia.org/wiki/Monarch_butterfly

Mountain Pine Beetle & Pine trees

<http://www.climate.org/topics/ecosystems/beetle-battle.html>
http://www.nps.gov/romo/learn/nature/mtn_pine_beetle_background.htm
<http://www.fs.fed.us/rmrs/docs/bark-beetle/faq.pdf>
<http://www.pc.gc.ca/eng/docs/v-g/dpp-mpb/sec2/dpp-mpb2c.aspx>
<http://www.pc.gc.ca/eng/docs/v-g/dpp-mpb/sec2.aspx>
https://en.wikipedia.org/wiki/Mountain_pine_beetle

Blue Crabs

<http://chesapeakebay.noaa.gov/fish-facts/blue-crab>
https://sta.uwi.edu/fst/lifesciences/documents/Callinectes_sapidus.pdf
<http://www.bioone.org/doi/full/10.1651/09-3241.1>
http://www.vims.edu/research/topics/blue_crabs/index.php
http://www.chesapeakebay.net/fieldguide/critter/blue_crab
http://www.sms.si.edu/irlspec/callin_sapidu.htm
https://en.wikipedia.org/wiki/Callinectes_sapidus

Burrowing Owl

http://www.allaboutbirds.org/guide/Burrowing_Owl/lifehistory/ac
<http://people.oregonstate.edu/~rosenbed/articles/Brochure.pdf>
<http://www.blm.gov/pgdata/etc/medialib/blm/wy/wildlife/animal-assessmnts.Par.52462.File.dat/WesternBurrowingOwl.pdf>
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https://en.wikipedia.org/wiki/Burrowing_owl

Greater Sage Grouse

http://www.allaboutbirds.org/guide/Greater_Sage-Grouse/lifehistory

<http://www.fws.gov/greatersagegrouse/>

<https://www.audubon.org/conservation/issues/greater-sage-grouse>

<http://climate.audubon.org/birds/saggro/greater-sage-grouse>

http://www.stateofthebirds.org/2014%20SotB_FINAL_low-res.pdf

http://www.stateofthebirds.org/2010/pdf_files/State%20of%20the%20Birds_FINAL.pdf

https://en.wikipedia.org/wiki/Greater_sage-grouse

Plant

Plant disease Wheat Stripe Rust

<http://www.ars.usda.gov/Main/docs.htm?docid=9918>

<https://extension.usu.edu/files/publications/factsheet/wheat-stripe-rust08.pdf>

<https://www.sciencenews.org/sites/default/files/13081>

<http://www.k-state.edu/pdecology/GarrettNita2009.pdf> (p425-429, p434-435)

https://en.wikipedia.org/wiki/Wheat_yellow_rust

Harp Seal

<http://www.nmfs.noaa.gov/pr/species/mammals/pinnipeds/harpseal.htm>

<http://animals.nationalgeographic.com/animals/mammals/harp-seal/>

<http://www.iucnredlist.org/details/41671/0>

<http://www.scientificamerican.com/article/climate-change-life-harder-baby-harp-seals/>

https://en.wikipedia.org/wiki/Harp_seal

Loggerhead Sea Turtle

<http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/loggerhead-sea-turtle.htm>

<http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm>

http://www.conserveturtles.org/seaturtleinformation.php?page=climate_change

<http://news.nationalgeographic.com/news/2014/03/140317-turtles-green-turtles-scattered-islands-europa-mayotte-glorieuses-longlining-bycatch-world/>

http://seaturtlestatus.org/sites/swot/files/report/033111_SWOT6_p12-13_Climate%20Change.pdf

https://en.wikipedia.org/wiki/Loggerhead_sea_turtle

Coral Reef Impacts

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<http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F>
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MU professor, Dr. Candice Galen's Bumblebee research

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Summary Versions:

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<http://www.nature.com/news/bee-tongues-tell-a-tale-of-climate-change-1.18430>

<http://www.sciencedaily.com/releases/2015/09/150925093233.htm>

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<http://conservationmagazine.org/2015/09/climate-change-is-shortening-bumblebee-tongues/>

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