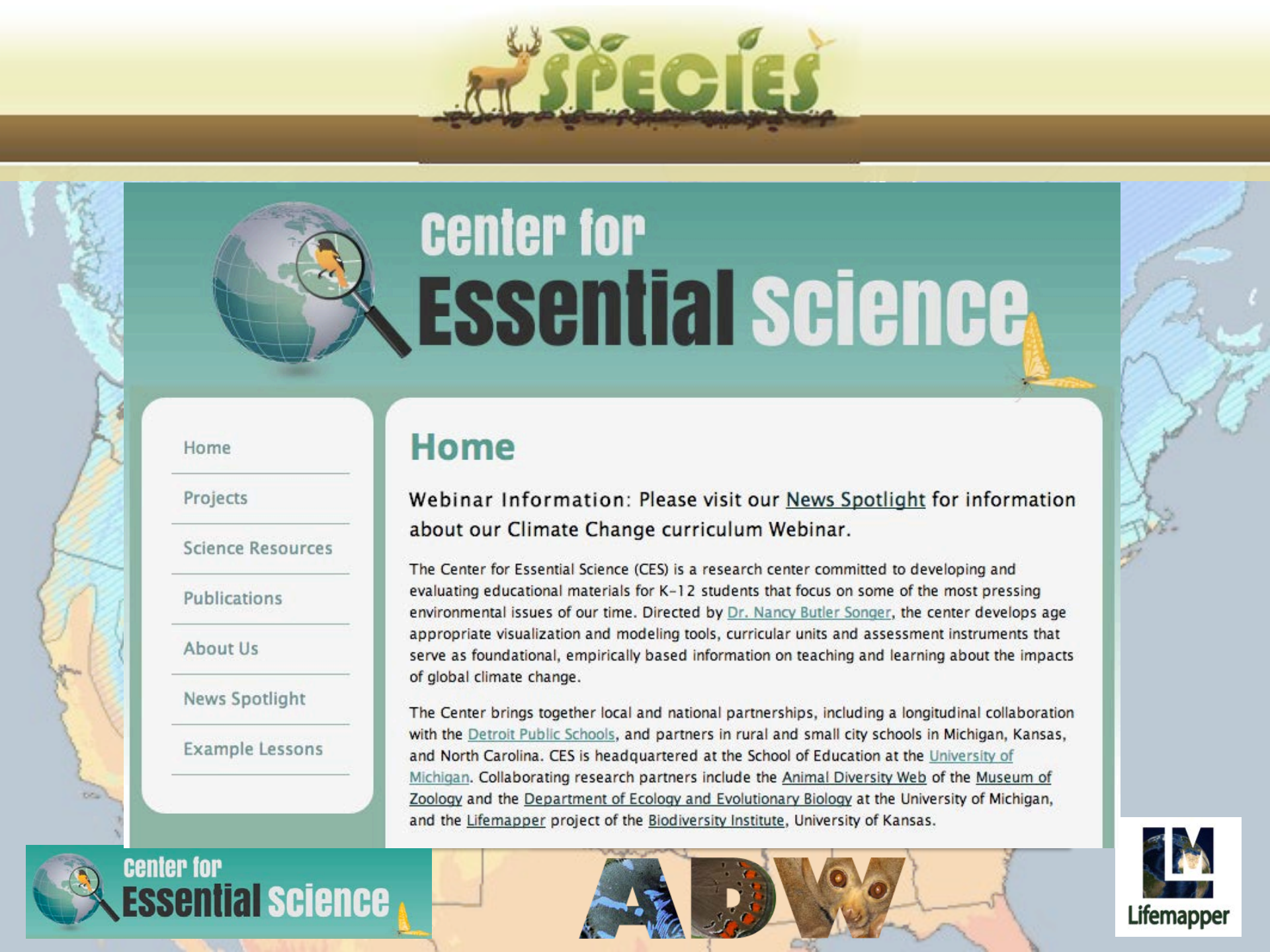

SPECIES
Center for
Essential Science
Home
Projects
Science Resources
Publications
About Us
News Spotlight
Example Lessons
Home
Webinar Information: Please visit our News Spotlight for information about our Climate Change curriculum Webinar.
The Center for Essential Science (CES) is a research center committed to developing and evaluating educational materials for K-12 students that focus on some of the most pressing environmental issues of our time. Directed by Dr. Nancy Butler Songer, the center develops age appropriate visualization and modeling tools, curricular units and assessment instruments that serve as foundational, empirically based information on teaching and learning about the impacts of global climate change.
The Center brings together local and national partnerships, including a longitudinal collaboration with the Detroit Public Schools, and partners in rural and small city schools in Michigan, Kansas, and North Carolina. CES is headquartered at the School of Education at the University of Michigan. Collaborating research partners include the Animal Diversity Web of the Museum of Zoology and the Department of Ecology and Evolutionary Biology at the University of Michigan, and the Lifemapper project of the Biodiversity Institute, University of Kansas.
Center for
Essential Science
ADW
Lifemapper


SPECIES
BIOKIDS
Kids' Inquiry of Diverse Species
CyberTracker Tools
ChangeThinking
Animal Diversity Web
Search
Critter Catalog
Field Guides
Research
Resources
About Us
Glossary
Help
TOOLS
Critter Catalog
Field Guides:
Tracks & Sign,
Invertebrate ID, Michigan
Habitat, Conservation
Status
BIOKIDS
Kids' Inquiry of Diverse Species
Search
Featuring
Wood frog
Rana sylvatica
Center for
Essential Science
ADW
Lifemapper

SPECIES

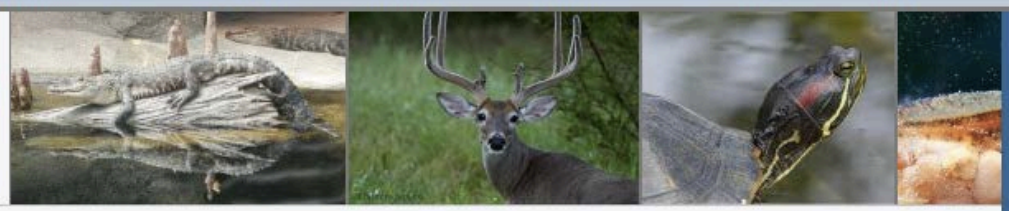
BIOKIDS Kids' Inquiry of Diverse Species

CyberTracker Tools
ChangeThinking
Animal Diversity Web

Search

Critter Catalog | Field Guides | Research | Resources | About Us | Glossary | Help

Critter Catalog



Welcome to the Critter Catalog!

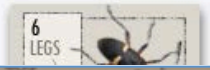
mammals

birds

reptiles

amphibians

fish



Here is information about many common animals found in Michigan, and a few that live in other places. You could find many of these animals in or around your schoolyard. Remember that this is just a little bit of animal biodiversity. There are many many other kinds of animals in other places. If you want to learn about animals that don't live in southeast Michigan, you can go to the Animal Diversity Web.

Mammals, birds, reptiles, amphibians, and fish are all **vertebrates** - they have a "spinal column" made up of many bones.

While vertebrates are more familiar to most people, there are many, many more species of **invertebrates**. In Michigan alone there

Center for Essential Science

ADW

Lifemapper

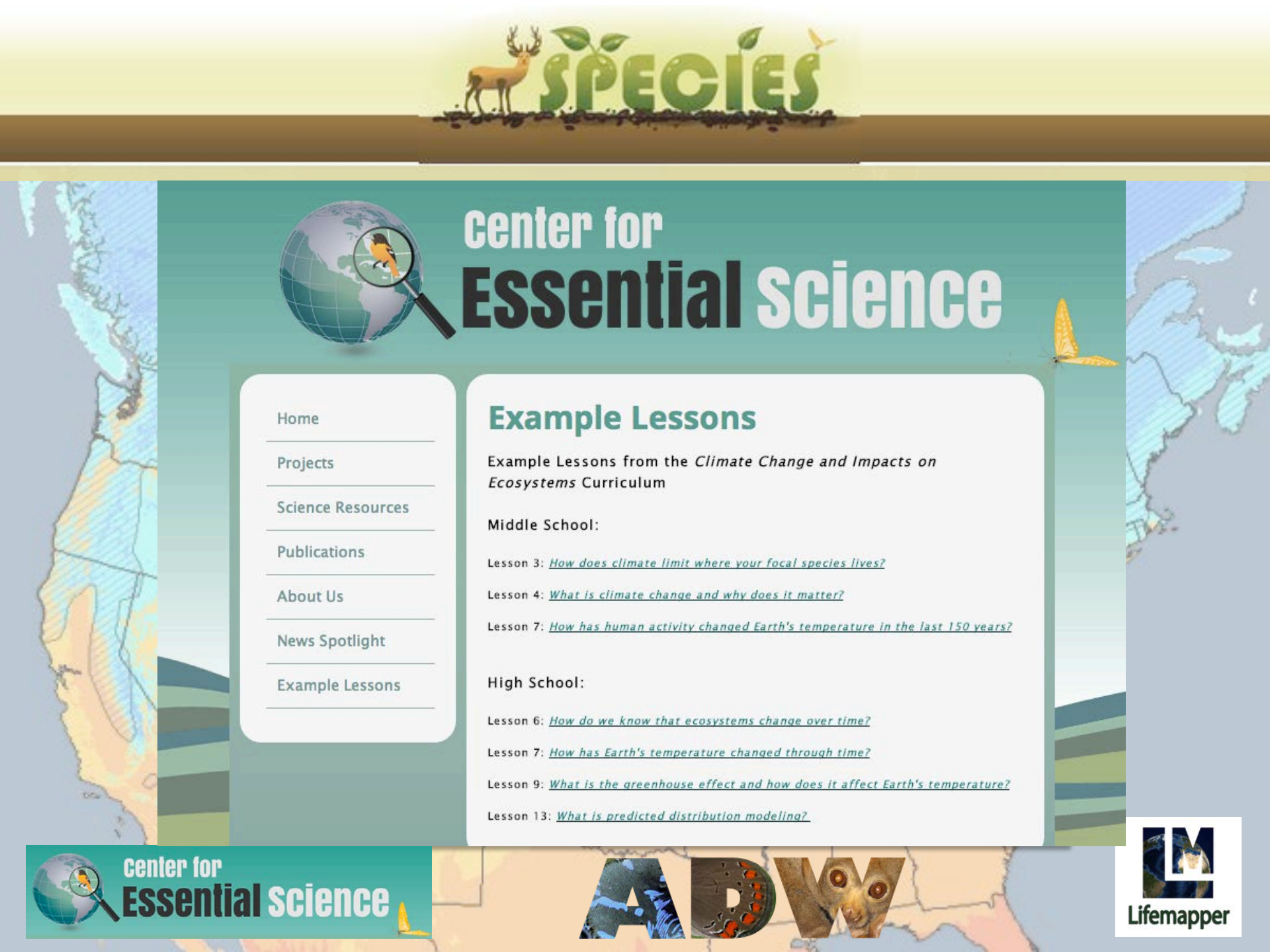

SPECIES
Animal Diversity Web
ADW
University of Michigan
MUSEUM OF ZOOLOGY
Home
About Us
About Animal Names
Teaching Resources
Special Collections
Glossary
Browse Animalia
Browse Animalia
AMPHIBIA
frogs, salamanders, and caecilians
Acris gryllus
Southern Cricket Frog
Annelida
segmented worms
Chondrichthyes
rays, sharks, and
Insecta
insects
Take our survey!
Help us improve the site!
Search ADW
Taxon Information
Explore Data @ Quaardvark
Search Guide
ADW Mission
The Animal Diversity Web is an online database and encyclopedia of animal natural history, built through contributions from students, photographers, and many others.
It is a rich and flexible resource designed both as an encyclopedia for
Center for Essential Science
ADW
Lifemapper

Home
Projects
Science Resources
Publications
About Us
News Spotlight
Example Lessons

Projects

In education, there is an urgent need to build a solid, research-based foundation about a new and essential focus area within pre-college science education: students' complex inquiry reasoning about the ecological impacts of global climate change. The Change Thinking for Global Science: Fostering and Evaluating the Ecological Impacts of Climate Change project serves as the major research vehicle for research questions in several interrelated areas. The research design involves a series of quasi-experimental studies that will complement each other and provide multiple lenses for understanding complex questions about learning. Our research questions are:

1. Which scientific content and reasoning skills are essential for 7-10th graders' complex reasoning and modeling of the ecological impacts of climate change? How are these manifested in content and inquiry reasoning progressions?
2. What dynamic visualization and modeling resources support the development of deep thinking about the ecological impacts of climate change?
3. What scaffolding and instructional activities support the development of deep thinking about the ecological impacts of climate change, including both content (ecological impacts) and complex reasoning components (scientific practices) of this knowledge, within cohorts of 7-10th graders in two new curricular units?


SPECIES
center for
Essential Science
Home
Projects
Science Resources
Publications
About Us
News Spotlight
Example Lessons
Example Lessons
Example Lessons from the *Climate Change and Impacts on Ecosystems* Curriculum
Middle School:
Lesson 3: How does climate limit where your focal species lives?
Lesson 4: What is climate change and why does it matter?
Lesson 7: How has human activity changed Earth's temperature in the last 150 years?
High School:
Lesson 6: How do we know that ecosystems change over time?
Lesson 7: How has Earth's temperature changed through time?
Lesson 9: What is the greenhouse effect and how does it affect Earth's temperature?
Lesson 13: What is predicted distribution modeling?
center for
Essential Science
ADW
Lifemapper

Welcome to SPECIES!

We would like to welcome you to SPECIES, the online learning environment for the Center for Essential Science's *Climate Change and Impacts on Ecosystems* curriculum. As you work through the Learning Sets, you will be introduced to the many different features of this website. In addition to using the online notebook for your activites, you will also be using a number of fun learning resources, including videos, maps and charts, and a species distribution modeling tool.

This website works best in the following browsers: IE8+, Chrome, Safari and Firefox 3.6+.

We are really excited that you will be working with SPECIES, and hope that you have a great time exploring the environment and learning about climate change and climate change impacts.

The ChangeThinking Research Team

This material is based upon work supported by the National Science Foundation under Grant No. 0918590. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Lesson 4 Overview

DRIVING QUESTION: *What is the difference between weather and climate?*

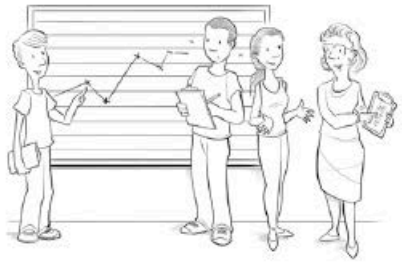
LEARNING GOALS:

- Students *analyze data* to identify patterns of average temperature over the past 100 and 400 years.
- *Create a scientific explanation* about the difference between weather and climate for global temperature by answering the scientific question, "Is global temperature changing because of weather?"
- Students *use representations* to investigate the impact of a degree change in temperature on Earth's processes.

TOTAL TIME: 220 minutes or approximately 4 class periods

LESSON SUMMARY:

Students will understand the difference between weather and climate. They will analyze weather and climate temperature data to learn about global trends in temperature. Through a hands-on activity, students will see how small changes in global temperature can potentially have large impacts on the environment.



MATERIALS:

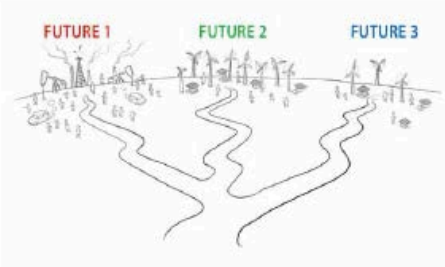
- *Stearic Acid Lab materials*
- *Water bath, thermometers, and beakers (3)*

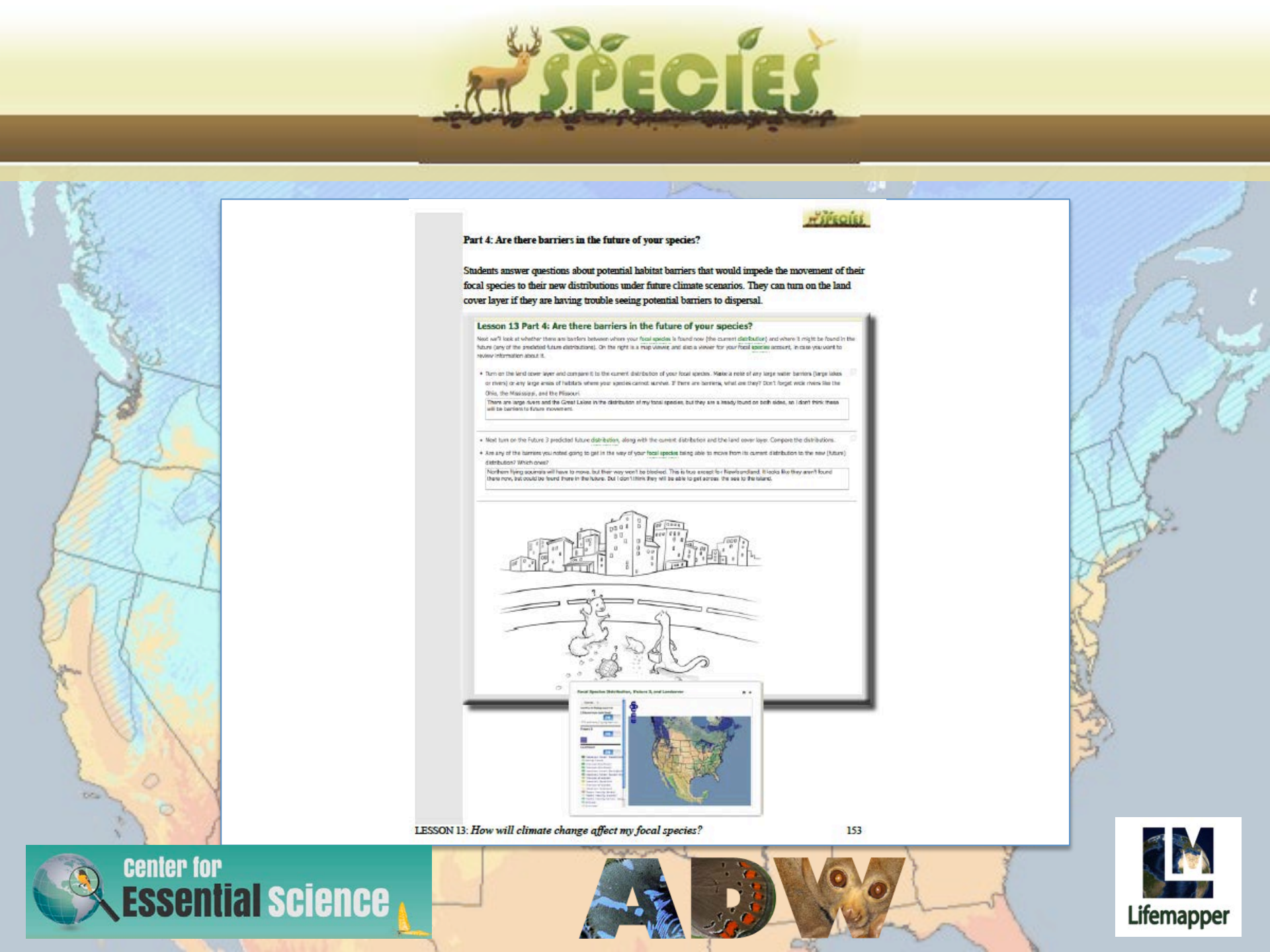
Part 1: Prediction: Can your focal species live in your state?

Students then construct a justified prediction to answer the scientific question "Can your focal species live in your state?"

Part 5: Lesson Synthesis

Students construct a justified prediction to summarize their exploration of the question "how will climate change affect my focal species?"





Part 4: Are there barriers in the future of your species?

Students answer questions about potential habitat barriers that would impede the movement of their focal species to their new distributions under future climate scenarios. They can turn on the land cover layer if they are having trouble seeing potential barriers to dispersal.

Lesson 13 Part 4: Are there barriers in the future of your species?

Next we'll look at whether there are barriers between where your focal species is found now (the current distribution) and where it might be found in the future (any of the predicted future distributions). On the right is a map viewer and also a viewer for your focal species account, in case you want to review information about it.

- Turn on the land cover layer and compare it to the current distribution of your focal species. Make a note of any large water barriers (large lakes or rivers) or any large areas of habitats where your species cannot survive. If there are barriers, what are they? Don't forget wide rivers like the Ohio, the Mississippi, and the Missouri.

  There are large rivers and the Great Lakes in the distribution of my focal species, but they are already found on both sides, so I don't think these will be barriers to future movement.

- Next turn on the Future 3 predicted future distribution, along with the current distribution and the land cover layer. Compare the distributions.
- Are any of the barriers you noted going to get in the way of your focal species being able to move from its current distribution to the new (future) distribution? Which ones?

  Northern flying squirrels will have to move, but their way won't be blocked. This is true except for Florida proband. It looks like they aren't found there now, but could be found there in the future. But I don't think they will be able to get across the sea to the island.

LESSON 13: *How will climate change affect my focal species?* 153

Center for Essential Science

Lifemapper


SPECIES
Hello, tdewey! | Hide Teacher Text | Manage Workspaces | Logout
SPECIES
Contents
Climate Change and Impacts on Ecosystems - High School Spring 2013
Welcome to SPECIES!
Lesson 1 - How will climate change affect species?
Lesson 1 - Introduction
Lesson 1 - Research Paper Design
Lesson 1 - Research Paper Instructions
Lesson 2 - What influences where species are found in the world?
Lesson 2 Part 1
Lesson 2 Part 2
Lesson 2 Part 3
Lesson 3 - How does climate limit where your focal species lives?
Lesson 3 - Introduction
Lesson 3 - Part 1
Lesson 3 - Part 2
Lesson 4 - What is the difference between weather and climate?
Lesson 4 Part 1
Lesson 4 Part 2
Lesson 4 Part 3
Lesson 4 Part 4
Lesson 4 Part 5
Lesson 5 - How do we know that ecosystems change over time?
Lesson 5 - Part 1
Lesson 5 - Part 2
Lesson 5 - Part 3
Lesson 6 - How has Earth's temperature changed through time?
Lesson 6 Part 1
Home » Lessons » Welcome to SPECIES!
Welcome to SPECIES!
SPECIES is the online learning environment for the Clim
When logged in to SPECIES, student are able to record
to use SPECIES below (visible to students), but here are
The SPECIES interface contains all or most of the ma
As a teacher you can access any part of the curriculu
right.
There is a feedback section at the end of each page.
the lessons.
You will also be given a paper notebook to record yo
write them down.
Thank you for your help! The Climate Change and Impa
University of Michigan, Ann Arbor
Center for
Essential Science
ADW
Lifemapper

Lesson 13 Part 1: How will climate change affect my focal species?

You looked at predicted distribution modeling using Sasquatch data. Now you are going to explore the impacts of future climate change on your focal species. In a previous activity (Lesson 4) you used abiotic conditions to make a claim about whether your focal species could live in a particular area. In this lesson, you will be able to predict where your focal species could live under different future climate scenarios, where a prey of your focal species could live under different future climate scenarios, and conclude with how habitat impacts where your focal species could be found. You will conclude the lesson by synthesizing all of the information to answer the scientific question, "How will climate change affect my focal species?"

Resources

Temperature
Precipitation and
Focal Species Map

After working with the Sasquatch example from the previous lesson, you will apply your predicted distribution modeling skills to your focal species. You already know the current distribution of your focal species from Lesson 3.

As a refresher, look over the current distribution of your focal species, and the precipitation and temperature layers, to remind yourself of the abiotic conditions that limit where your focal species is found.

Next, you will examine the impacts of the IPCC Climate Scenarios for Futures 1-3 on your focal species and a prey species. We will consider not only how these futures might influence global climate, but also how they might impact the distribution and interactions of species on Earth. The description of the IPCC futures is on page 20 of your student binder.

Focal Species Chooser

(Cardinalis cardinalis)

northern flying squirrel
(Glaucomys sabrinus)

northern leopard frog
(Rana pipiens)

northern pike (Esox lucius)

northern short-tailed shrew
(Blarina brevicauda)

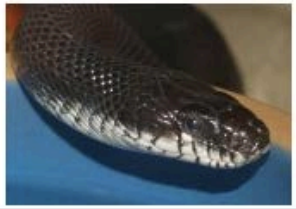
northern water snake
(Nerodia sipedon)

plains garter snake
(Thamnophis radix)

rat snake (Elaphe obsoleta)







Black rat snake

Elaphe obsoleta

What do they look like?

The common rat snake is medium-sized, averaging 42-72 inches (106.7-183 cm) in length (Conant and Collins 1998). At the widest point of the snake's body, the average diameter is 1.5 inches (3.8 cm) (Staszko and Walls 1994). Rat snakes are covered with keeled scales. They have a powerful slender body with a wedge-shaped head (Mattison 1990). These snakes come in a variety of subspecies. The black rat snake is the one most commonly found in Michigan.

Center for Essential Science

ADW

Lifemapper

Temperature Precipitation and Focal Species Map

Species...

rat snake (Elaphe obsoleta)

ON

rat_snake

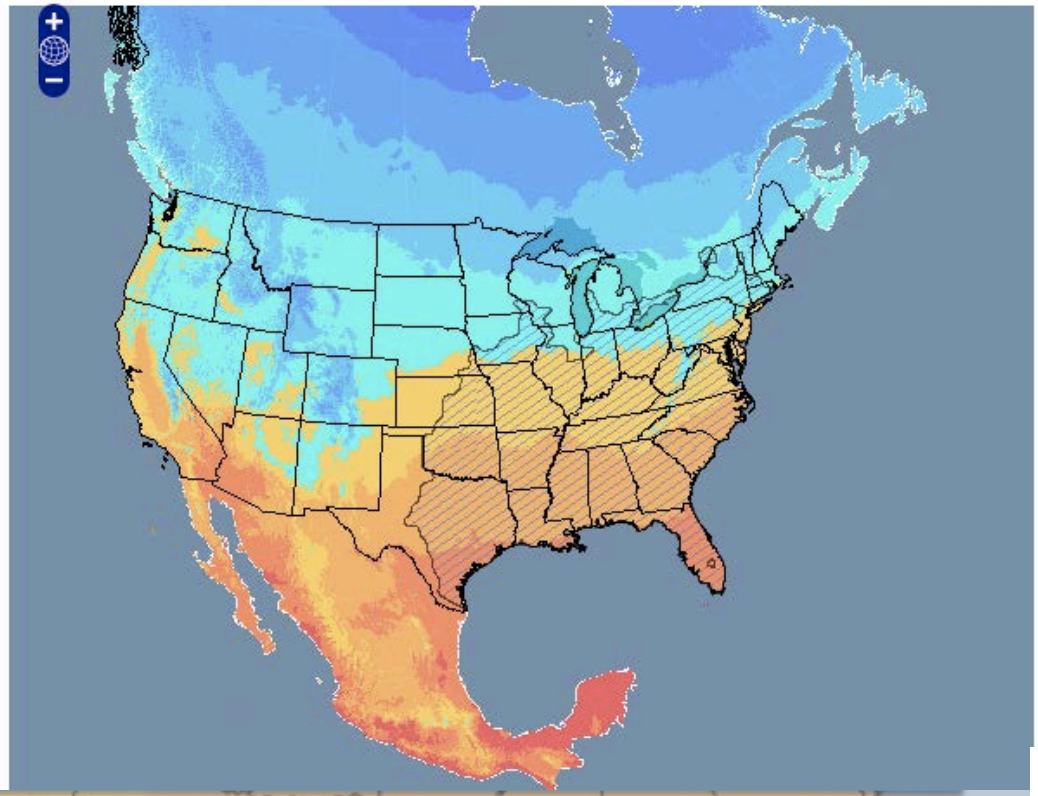
Annual Temperature

ON

- 25 C thru 29.9 C
- 20 C thru 24.9 C
- 15 C thru 19.9 C
- 10 C thru 14.9 C
- 5 C thru 9.9 C
- 0 C thru 4.9 C
- -5 C thru -.1 C
- -10 C thru -5.1 C
- -15 C thru -10.1 C
- -20 C thru -15.1 C
- -30 C thru -20.1 C

Annual Precipitation

OFF



Center for Essential Science

ADW

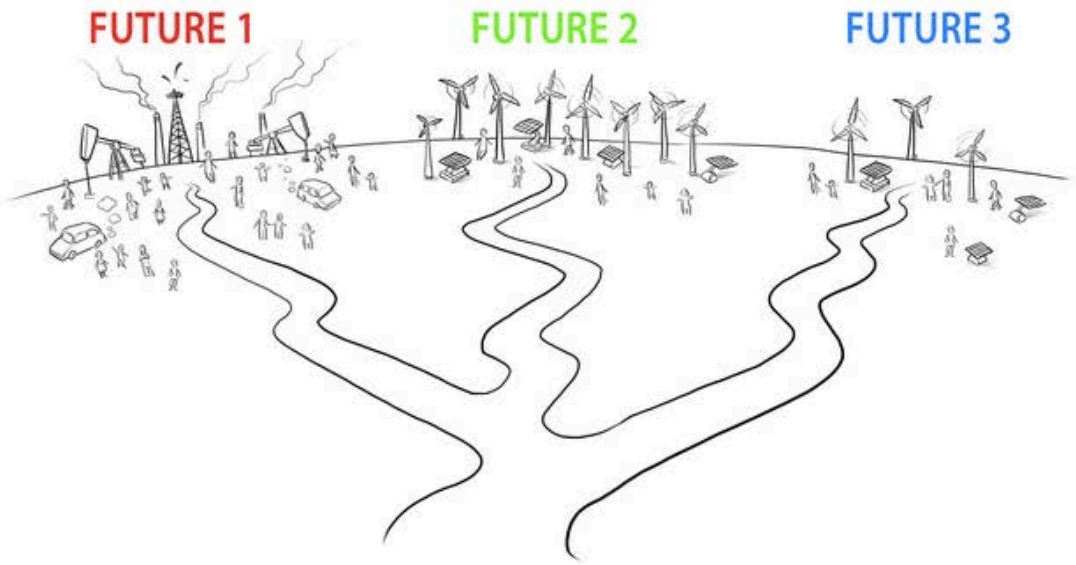
Lifemapper

Lesson 13 Part 2: How will climate change affect my focal species?

- Open the the map viewer resource on the right. Turn on the layer for the current distribution of your focal species. Take a look and then turn on the layer for Future 1. Compare the current distribution of your focal species with the predicted distribution under Future 1. Read the description of Future 1 (you learned about this Future in Lesson 8, see page 20 in your student notebook).

Resources

Focal Species Current and Predicted Future Distributions



Focal Species Current and Predicted Future Distributions

Species...

rat snake (Elaphe obsoleta)

ON

rat_snake

Future 1

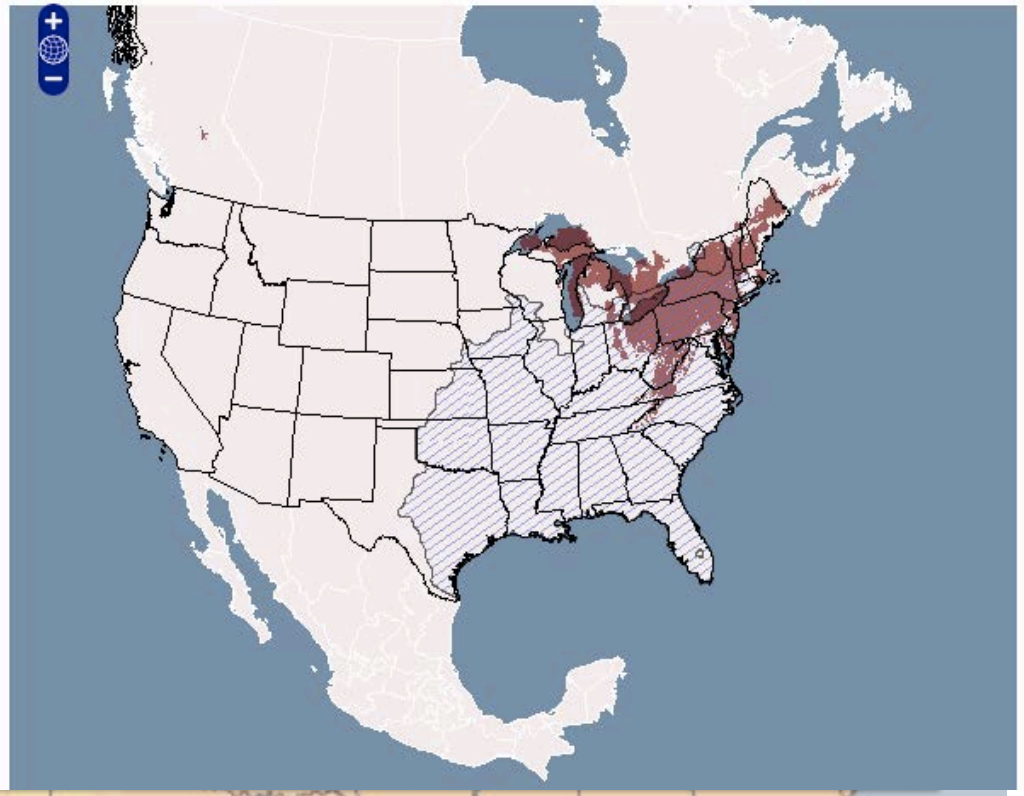
ON

Future 2

OFF

Future 3

OFF



Center for Essential Science

ADW

Lifemapper

Lesson 13 Part 3: Where will the prey of your focal species live under different future climate scenarios?

You have just looked at how three possible future climate scenarios affect the distribution of your focal species. Remember that these scenarios only consider abiotic information, such as temperature and precipitation. Next, look at information on a prey of your focal species and think about how the distribution of that prey species might influence your focal species in the future. Compare the distributions of your focal species and its prey under Future 3 and Future 1.

Resources

Future Distributions of Focal Species and Prey

Focal Species Viewer

Refresher: What are prey?

Prey are animals that another animal eats.

Why are prey important for the survival of your focal species?

Northern flying squirrels eat mainly fungi and nuts. They eat eggs and insects sometimes, but I don't think they rely on their prey.

Do you expect the distribution of your focal species to overlap with the distribution of a species that it eats (prey)?

Yes, a predator wouldn't be able t

Future Distributions of Focal Species and Prey

Species...

rat snake (Elaphe obsoleta)

ON

rat_snake

southern red-backed vole (Myodes gapperi)

ON

southern_red_backed_vole

Future 1

rat snake (Elaphe obsoleta)

OFF

Future 1

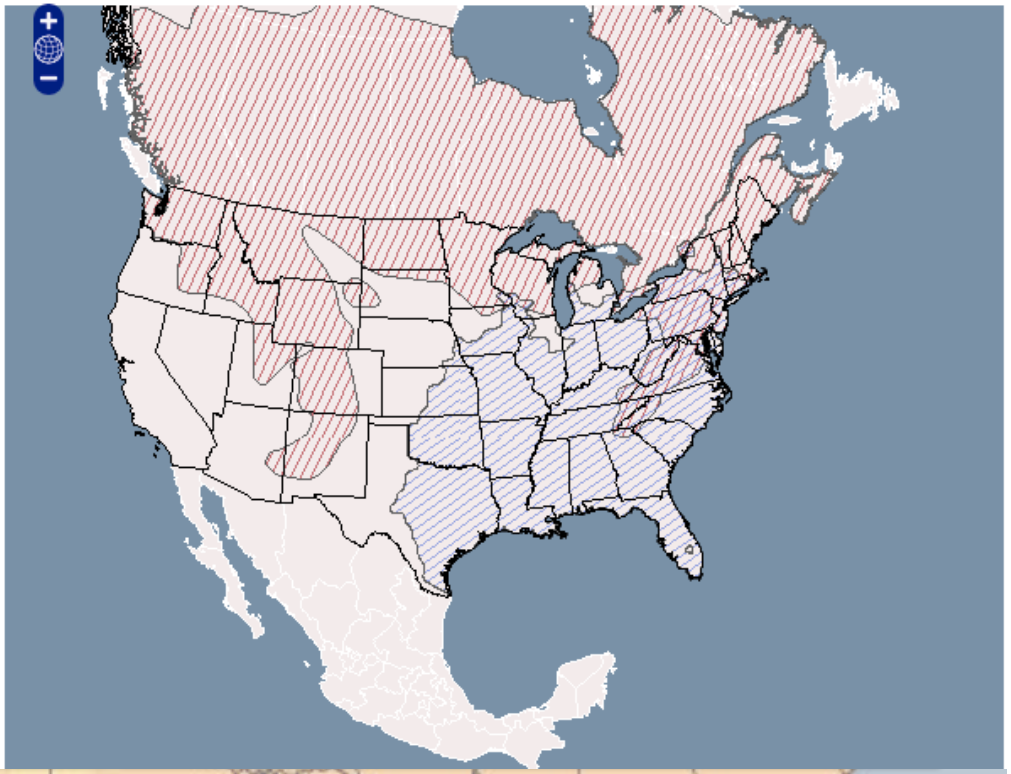
southern red-backed vole (Myodes gapperi)

OFF

Future 2

rat snake (Elaphe obsoleta)

OFF



Center for Essential Science

ADW

Lifemapper

Future Distributions of Focal Species and Prey

Species...

rat snake (Elaphe obsoleta)

OFF

southern red-backed vole (Myodes gapperi)

OFF

Future 1

rat snake (Elaphe obsoleta)

ON

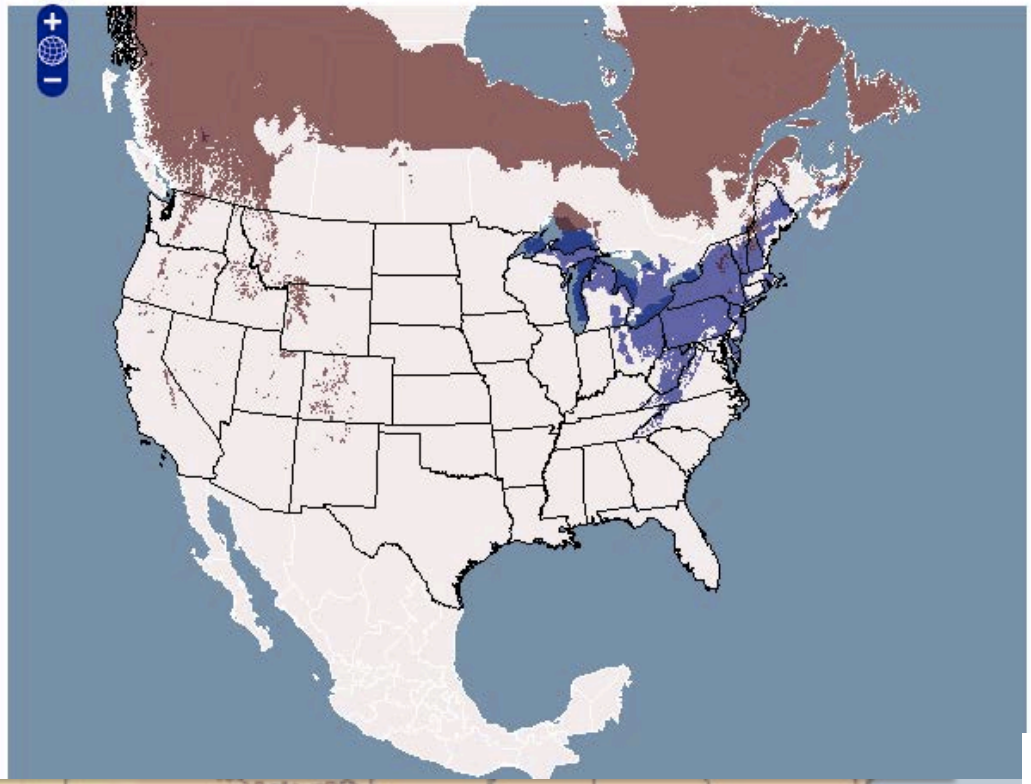
Future 1

southern red-backed vole (Myodes gapperi)

ON

Future 2

rat snake (Elaphe obsoleta)



Center for Essential Science

ADW

Lifemapper

Focal Species Distribution, Future 3, and Landcover

Species...

rat snake (Elaphe obsoleta)

ON

rat_snake

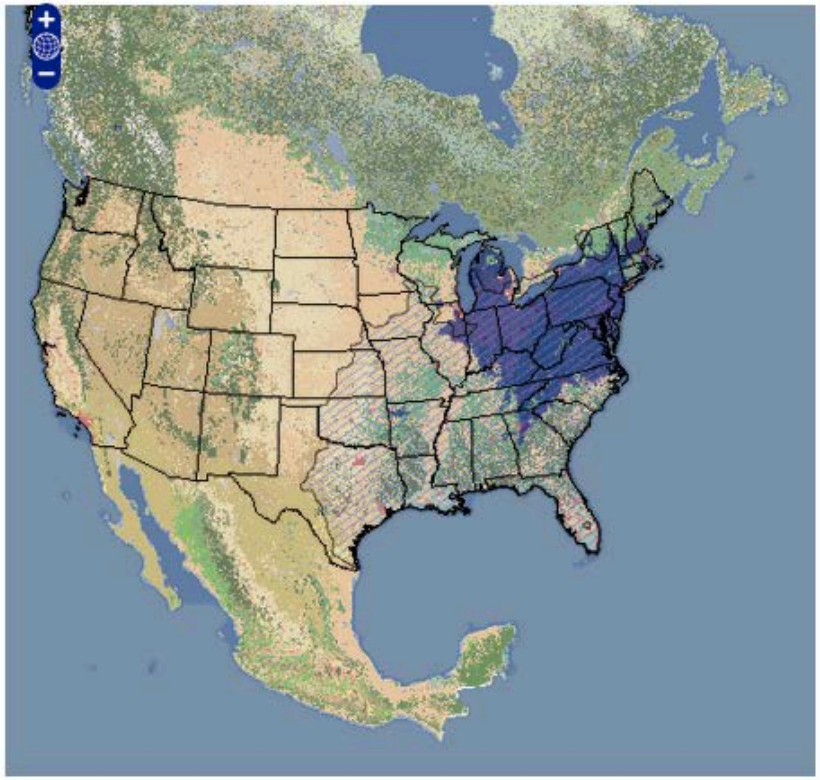
Future 3

ON

Landcover

ON

- Temperate Forest (needlelea
- Boreal Forest
- Tropical Rainforest
- Tropical Dry Forest
- Temperate Forest (broadleaf
- Temperate Forest (mixed tre
- Tropical Grassland
- Temperate Shrubland
- Tropical Grassland
- Temperate Grassland
- Tundra (mostly shrubs)
- Tundra (mostly grasses)
- Tundra (mostly barren, some
- Wetland
- Cropland
- Barren lands



Center for Essential Science

ADW

Lifemapper


FUTURE 1
FUTURE 2
FUTURE 3