ECOSYSTEMS:
Interactions, Energy, and Resilience

This lesson plan was created by Prof. Katie Hinde, Arizona State University, using Next Generation Science Standards and explanations from the National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

Core Idea 2 LS2A-C Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

The Lesson Plan is designed to add a “real world” example for constructing a food web for a specific ecosystem based on 2022MMM combatants in WILD North America Division, using the species lists for Federal Public Lands: https://irma.nps.gov/NPSpecies/Search/SpeciesList and is designed to take 60-90 minutes depending on if teachers include a group collaboration on food webs after students create their own individual food web.

Linked Worksheets (dimensions are 7 x 10.5 so can be printed on standard paper) (editable)
Linked Presentation Slidedeck (editable)

LEARNING OBJECTIVES:
At the end of this assignment, students will be able to
-Explain different ecosystem roles within a food web
-Interpret and apply principles of food webs to real species in real ecosystems.
-Illustrate the complex relationships among 8 or more species within a food web
-Navigate to Federal Public Lands species lists to select and extract key information

There are 7 different species (Black Bear, Wolf, Cougar, Coyote, Bighorn Sheep, Elk, and Marmot) each species is matched to a specific park/public land and has a specific worksheet among the seven worksheets. Each student is assigned one species and given one of the worksheets.

The paired slideshow enables educators to present key information about ecosystems, food webs, and major groups of mammals. The slide show further describes the activity step-by-step to students. After conducting their research and completing the worksheet tables, students will then draw a food web of the species including the 2022 MMM combatant. After students complete their food web from their research, teachers can create groups of students who had the same species/park to compare the food webs they created and then combine them into a more elaborate food web (since there are MANY mammals in each park for students to choose among).

Teachers may consider modifying the lesson to incorporate
-more specific sleuthing of plants, insects, birds, reptiles, and fish within the park ecosystem
-narrow research to species adapted to specific river, lake, forest, plains, desert or systems;
-visit the website of their specific park (https://www.nps.gov/findapark/index.htm) to find specific threats, monitoring, and mitigation practices Park Staff are implementing to address climate change, look-up information about the cultural resources of the park, Indigenous land stewardship and traditional ecological knowledge (TEK; www.nps.gov/subjects/tek/description), and/or abiotic aspects of the natural systems within the park, human impacts and climate change within the specific park.
-visit the "Climate Change And Your National Parks" at www.nps.gov/subjects/climatechange to explore which effects of climate change are impacting their park: advancing spring onset, sea level change, and wildland fire.

BACKGROUND

Interdependent Relationships in Ecosystems
i. Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
ii. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
iii. Growth of organisms and population increases are limited by access to resources.

How and why do organisms interact with their environment and what are the effects of these interactions?

Ecosystems are complex, interactive systems that include both biological communities (biotic) and physical (abiotic) components of the environment. As with individual organisms, a hierarchal structure exists; groups of the same organisms (species) form populations, different populations interact to form communities, communities live within an ecosystem, and all of the

ecosystems on Earth make up the biosphere. Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. These same interactions can facilitate or restrain growth and enhance or limit the size of populations, maintaining the balance between available resources and those who consume them. These interactions can also change both biotic and abiotic characteristics of the environment. Like individual organisms, ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system. Ecosystems are dynamic, experiencing shifts in population composition and abundance and changes in the physical environment over time, which ultimately affects the stability and resilience of the entire system.

Ecosystems are ever changing because of the interdependence of organisms of the same or different species and the nonliving (physical) elements of the environment. Seeking matter and energy resources to sustain life, organisms in an ecosystem interact with one another in complex feeding hierarchies of producers, consumers, and decomposers, which together represent a food web. Interactions between organisms may be predatory, competitive, or mutually beneficial. Ecosystems have carrying capacities that limit the number of organisms (within populations) they can support. Individual survival and population sizes depend on such factors as predation, disease, availability of resources, and parameters of the physical environment. Organisms rely on physical factors, such as light, temperature, water, soil, and space for shelter and reproduction. Earth's varied combinations of these factors provide the physical environments in which its ecosystems (e.g., deserts, grasslands, rain forests, and coral reefs) develop and in which the diverse species of the planet live. Within any one ecosystem, the biotic interactions between organisms (e.g., competition, predation, and various types of facilitation, such as pollination) further influence their growth, survival, and reproduction, both individually and in terms of their populations.

By End of 8th Grade: Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

How do matter and energy move through an ecosystem?

Animals acquire matter from food, that is, from plants or other animals. The chemical elements that make up the molecules of organisms pass through food webs and the environment and are combined and recombined in different ways. At each level in a food web, some matter provides

energy for life functions, some is stored in newly made structures, and much is discarded to the surrounding environment. Only a small fraction of the matter consumed at one level is captured by the next level up. As matter cycles and energy flows through living systems and between living systems and the physical environment, matter and energy are conserved in each change.

The carbon cycle provides an example of matter cycling and energy flow in ecosystems. Photosynthesis, digestion of plant matter, respiration, and decomposition are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.

By the end of 8th Grade: Food webs are models that demonstrate how matter and energy is transferred between producers (generally plants and other organisms that engage in photosynthesis), consumers, and decomposers as the three groups interact—primarily for food—within an ecosystem.

What happens to ecosystems when the environment changes?

Ecosystems are dynamic in nature; their characteristics fluctuate over time, depending on changes in the environment and in the populations of various species. Disruptions in the physical and biological components of an ecosystem—which can lead to shifts in the types and numbers of the ecosystem's organisms, to the maintenance or the extinction of species, to the migration of species into or out of the region, or to the formation of new species (speciation)—occur for a variety of natural reasons. Changes may derive from the fall of canopy trees in a forest, for example, or from cataclysmic events, such as volcanic eruptions. But many changes are induced by human activity, such as resource extraction, adverse land use patterns, pollution, introduction of nonnative species, and global climate change. Extinction of species or evolution of new species may occur in response to significant ecosystem disruptions.

Species in an environment develop behavioral and physiological patterns that facilitate their survival under the prevailing conditions, but these patterns may be maladapted when conditions change or new species are introduced. Ecosystems with a wide variety of species—that is, greater biodiversity—tend to be more resilient to change than those with few species.

By the end of grade 8. Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations. Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

Name_____
Date _____
Class_____
Teacher_____

Hot Springs National Park

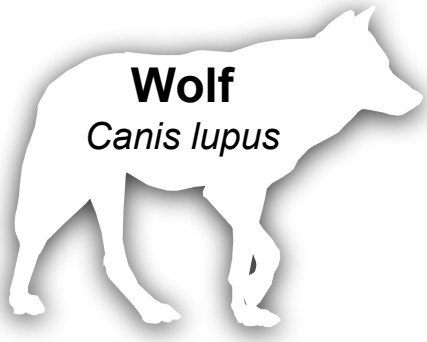
The 2022 March Mammal Madness WILD North America **BLACK BEAR** is from Hot Springs National Park in Arkansas. The park and its surrounding mountains exhibit a south-central United States pine-oak-hickory forest ecosystem. Within this system, black bears are omnivores, eating both plants and animals. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the Black Bear in the park ecosystem. First select your park (Hot Springs National Park), category (Mammals), click circle for full list.The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the "Occurence" column.

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You'll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select "vascular plant" species in the park, and you'll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Black Bear** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.



Name_____
Date _____
Class_____
Teacher_____

Superior National Forest

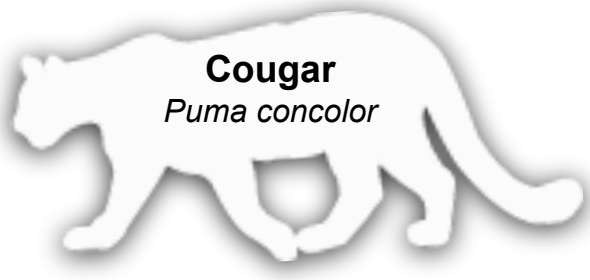
The 2022 March Mammal Madness WILD North America **WOLF** is from Superior National Forest in Minnesota and a boreal forest ecosystem. Within this system, wolves are carnivores, cooperatively hunting large herbivores. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the Black Bear in the park ecosystem. First select your park (Superior National Forest), category (Mammals), click circle for full list.The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the "Occurence" column.

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You'll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select "vascular plant" species in the park, and you'll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Wolf** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.



Name_____
Date _____
Class_____
Teacher_____

Santa Monica Mountains National Recreation Area

The 2022 March Mammal Madness WILD North America **COUGAR** is from the Santa Monica Mountains National Recreation Area in California. This public land and its surrounding mountains have many different ecosystems, including oak woodlands, valley oak savannas, coastal sage, and chaparral. Within this system, cougars are an apex predator hunting and eating many different mammals. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the Cougar in the park ecosystem. First select your park (Santa Monica Mountains National Recreation Area), category (Mammals), click circle for full list. The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the “Occurence” column.

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You’ll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select “vascular plant” species in the park, and you’ll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Cougar** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.

Name_____
Date _____
Class_____
Teacher_____

Bighorn Canyon National Recreation Area

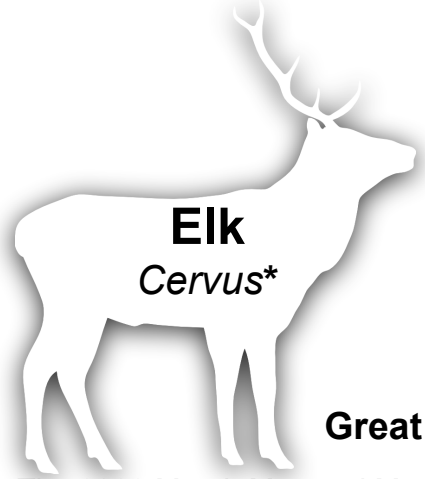
The 2022 March Mammal Madness WILD North America **BIGHORN SHEEP** is from the Bighorn Canyon National Recreation Area in Wyoming and Montana. This public land has multiple ecosystems including high desert juniper and sagebrush, montane forest, and great plains of prairie grasses and wildflowers. Within this system, bighorn sheep are herbivores that eat plants and stay vigilant for predators. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the bighorn sheep in the park ecosystem. First select your park (Bighorn Canyon National Recreation Area), category (Mammals), click circle for full list. The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the "Occurence" column.

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You'll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select "vascular plant" species in the park, and you'll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Bighorn Sheep** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.



Name_____
Date _____
Class_____
Teacher_____

Great Smokey Mountains National Park

The 2022 March Mammal Madness WILD North America **ELK** is from the Great Smokey Mountains National Park in Tennessee. Five forest types within the park support over 1,500 species of flowering plants and at least 4,000 non-flowering varieties. Within this system, elk are herbivores that eat plants. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the elk in the park ecosystem. First select your park (Great Smokey Mountains National Park), category (Mammals), click circle for full list. The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the "Occurence" column.

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You'll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select "vascular plant" species in the park, and you'll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Elk** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.

*Elk species and subspecies designations are not always used consistently among scientists & wildlife managers

Name_____
Date _____
Class_____
Teacher_____

Cuyahoga Valley National Park

The 2022 March Mammal Madness WILD North America **COYOTE** is from Cuyahoga Valley National Park in Ohio. The Park includes forest and grassland, as well as river and wetland ecosystems. Within this system, coyote are omnivores eating a mix of plants and smaller prey. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the coyote in the park ecosystem. First select your park (Cuyahoga Valley National Park), category (Mammals), click circle for full list. The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the “Occurence” column.

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You’ll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select “vascular plant” species in the park, and you’ll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Coyote** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.

Yellow-Bellied Marmot

Marmota flaviventris

Name_____
Date _____
Class_____
Teacher_____

Great Basin National Park

The 2022 March Mammal Madness WILD North America **MARMOT** is from Great Basin National Park in Nevada. The area includes desert, sagebrush scrub, and forest ecosystems. Within this system, marmots are herbivores, eating plants, and staying vigilant for predators. Working alone, go to irma.nps.gov/NPSpecies/Search/SpeciesList and look up other mammal species that live alongside the badger in the park ecosystem. First select your park (Great Basin National Park), category (Mammals), click circle for full list. The list will have dozens of species, many with familiar names. Find species and fill in species common names that match the criteria to complete the tables below. Make sure the species is currently in the park from the “Occurence” column.

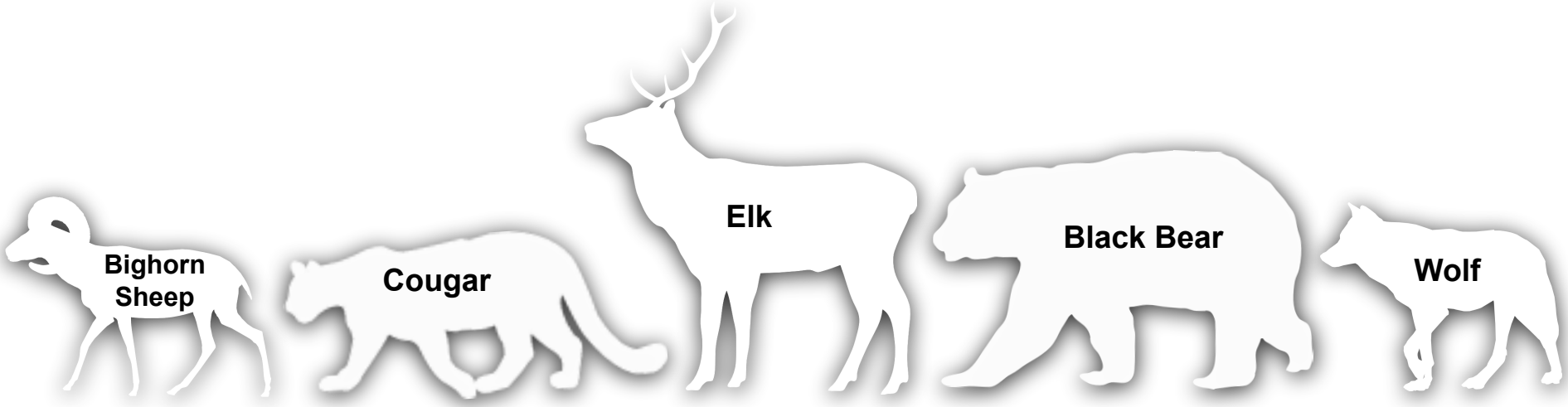
PRIMARY CONSUMERS			
Body Size	Small	Medium	Large
Order	Rodentia	Lagomorph	Artiodactyla
Species Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large
Order	Carnivora	Carnivora	Carnivora
Species Common Name			

In the park, there are dozens of mammal species. You’ll notice there are many different species of small rodents that eat plants, and many different species of small carnivores that eat the rodents, but far fewer species of large and very large mammals. You can also select “vascular plant” species in the park, and you’ll see many times more plant species than the number of mammal species.

On the back of this sheet of paper draw a diagram of the levels of the food web starting with plants. Include the **Marmot** and the other animals you added to the table above. Add arrows, labels, and a figure description to illustrate and explain what species eat what species and what species compete with what species.

ECOSYSTEMS: Interactions, Energy, and Dynamics



March Mammal Madness Combatants & their Ecosystems!

Silhouettes from PhyloPic.org: Margot Michaud, Steven Traver, Skye M, Becky Barnes, Chloe Schmidt, An Ignorant Atheist CC BY 3.0

Life Science Core Concepts sourced from the National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

ECOSYSTEMS: Interactions, Energy, and Dynamics

Interdependent Relationships in Ecosystems

A. Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.

B. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.

C. Growth of organisms and population increases are limited by access to resources.

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ECOSYSTEMS: Interactions, Energy, and Dynamics

Interdependent Relationships in Ecosystems

Ecosystems are complex, interactive systems that include both biological communities (biotic) and physical (abiotic) components of the environment.

For example, plants through photosynthesis turn sunlight into energy, get nutrients from soil, and collect water from soil and air to maintain cellular functions.

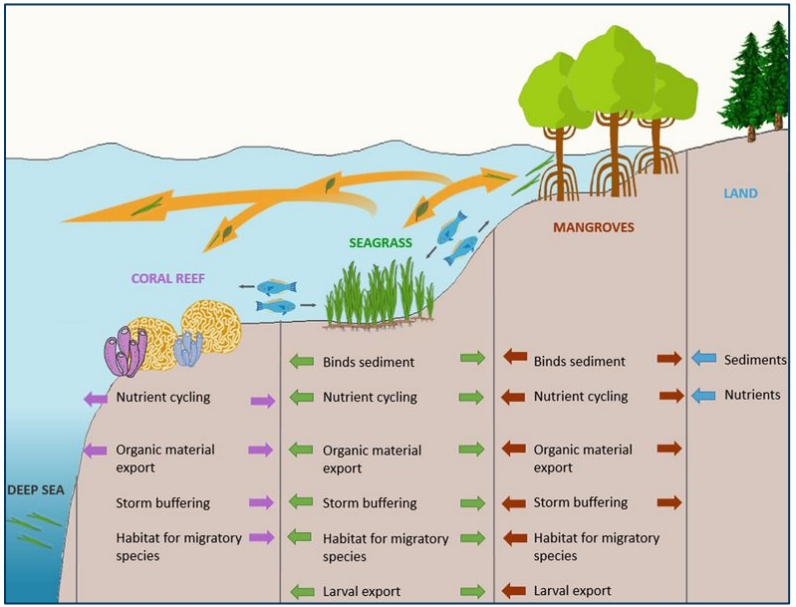
Life Science Core Concepts sourced from the National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165. Image: Dietmar Rabich

ECOSYSTEMS: Interactions, Energy, and Dynamics

Interdependent Relationships in Ecosystems

As with individual organisms, a hierarchal structure exists;

1) Groups of the same organisms (species) form populations
2) Different populations interact to form communities
3) Communities live within an ecosystem
4) All of the ecosystems on Earth make up the **biosphere**.



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ECOSYSTEMS: Interactions, Energy, and Dynamics

Interdependent Relationships in Ecosystems

Within a community food web, animals have traits that help them get their food- vision and smell help animals find and identify food; mouths, teeth, and/or beaks can help animals get and break down their food, and animals' organs digest food.

Animals also have traits to avoid becoming someone else's food- predator detection, escape, & defense.

In Kgalagadi Transfrontier Park in the Kalahari desert in South Africa, Botswana, and Namibia, the lion as predator is using phyical traits of claws, strength, & teeth after a behavioral predator tactic of ambush

while the eland is using physical traits of hard hooves, strength, and behavioral tactic of anti-predator kicking to try and escape.

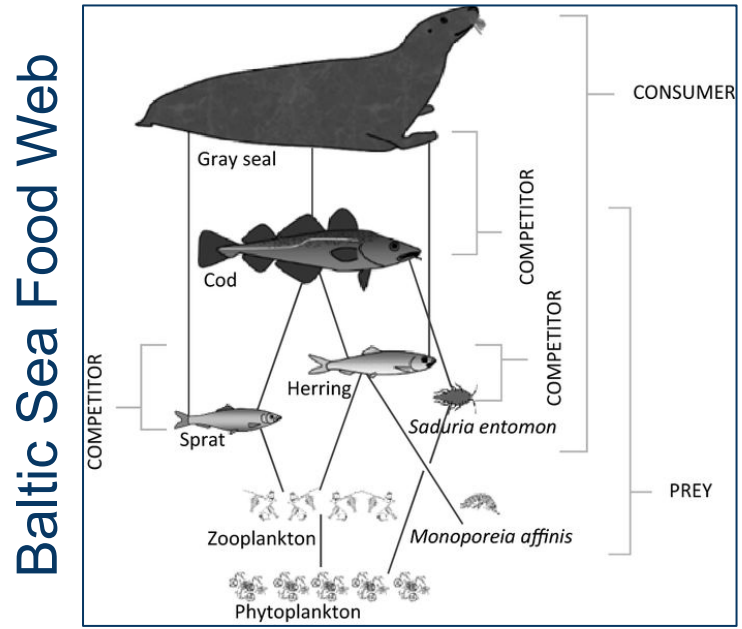
Life Science Core Concepts sourced from the National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165. Image by s9-4pr

ECOSYSTEMS: Interactions, Energy, and Dynamics

Interdependent Relationships in Ecosystems

Within a community food web in addition to getting things from “lower on the food chain” and avoiding species “up the food chain,” there can be **competition for resources with other organisms** that eat the same things.

For example, monkeys and megabats in the same ecosystem are often eating the same fruits; both coyotes and bobcats often hunt rodents and rabbits.



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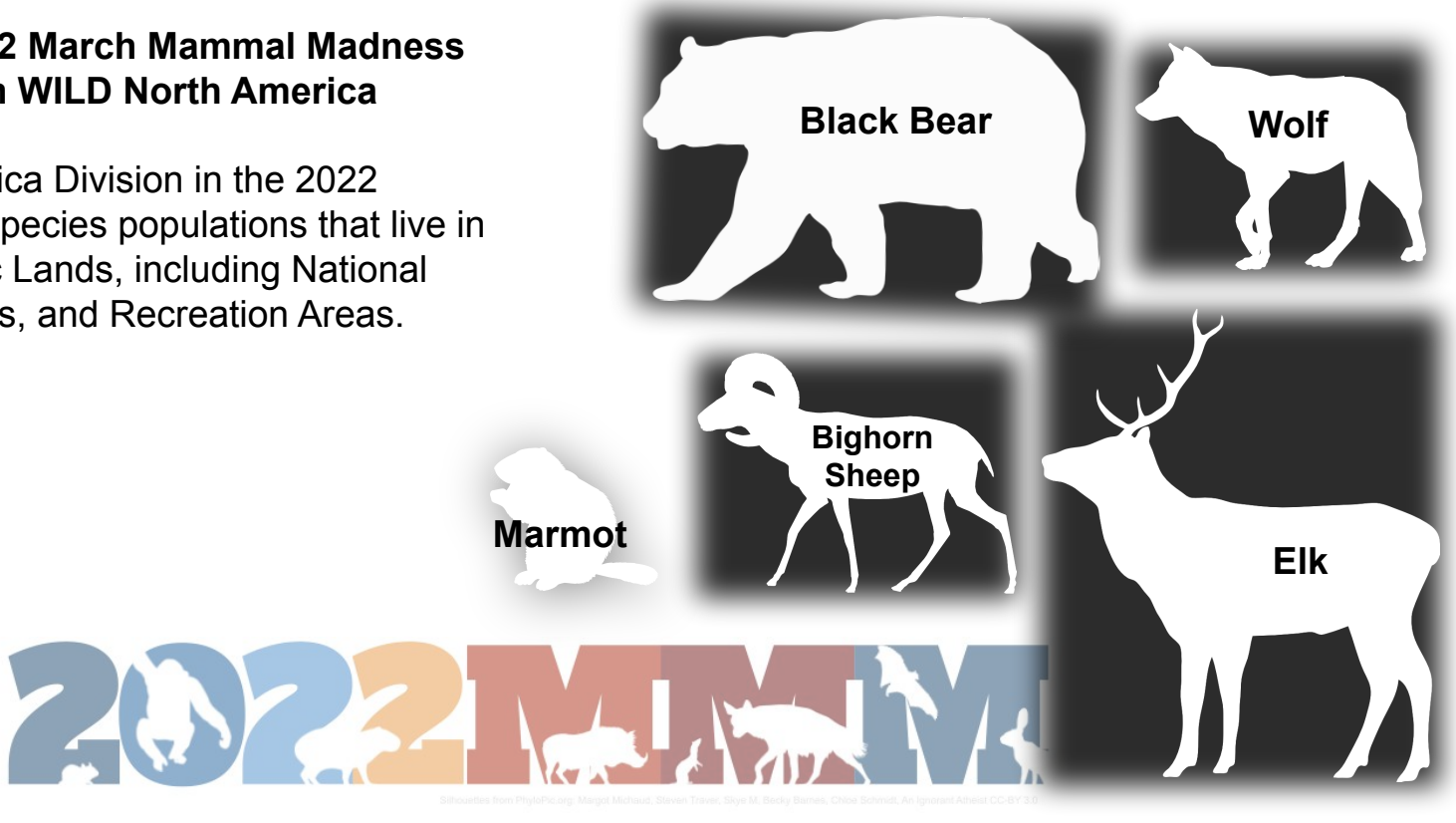
ECOSYSTEMS: Interactions, Energy, and Dynamics

Ecosystems of 2022 March Mammal Madness Combatants in WILD North America

The WILD North America Division in the 2022 Tournament features species populations that live in specific Federal Public Lands, including National Parks, National Forests, and Recreation Areas.



AMERICA'S PUBLIC LANDS

Public lands are areas of land and water that today are owned collectively by U.S. citizens and managed by government agencies.

Across the country, more than **640 million acres** are parks, forests, preserves, and historic sites that are open to the public.

Lands can be protected for recreation and conservation, preserved for their cultural significance, for wildlife, and the intrinsic value of the ecosystem.

Most federal public lands are managed by four agencies: National Park Service, Forest Service, Bureau of Land Management, and Fish and Wildlife Service within the Department of the Interior

https://www.doi.gov/blog/americas-public-lands-explained

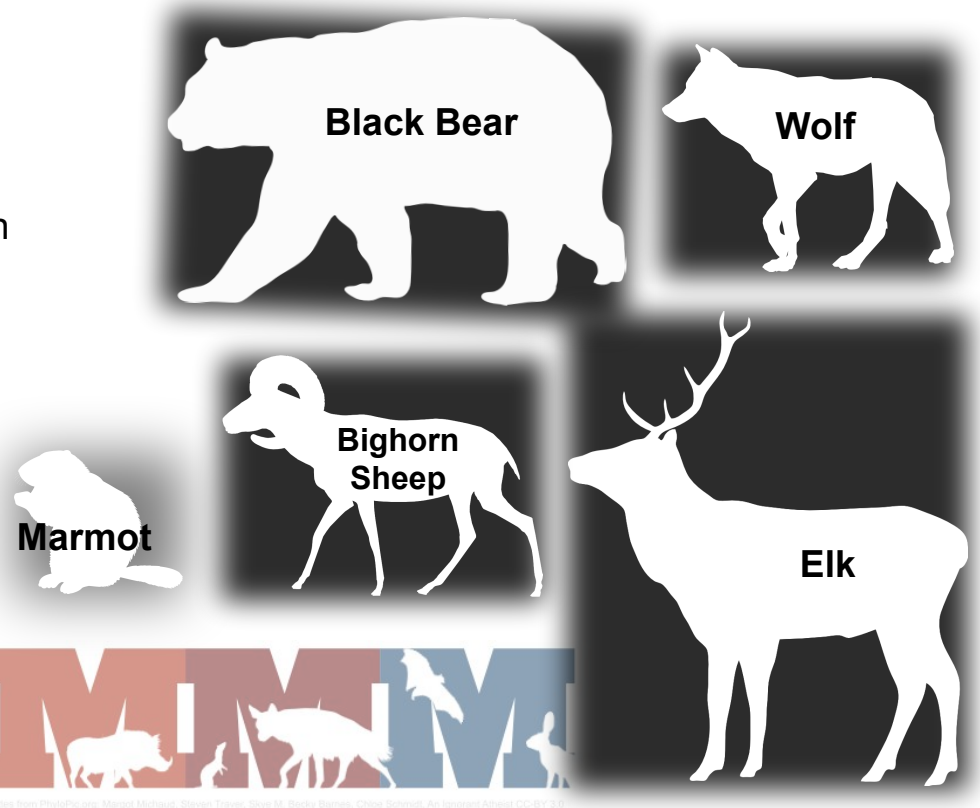
Top Image by Alan Schmierer
Bottom Image by Brocken Inaglory

ECOSYSTEMS: Interactions, Energy, and Dynamics

Ecosystems of 2022 March Mammal Madness Combatants in WILD North America

The WILD North America Division in the 2022 Tournament features species populations that live in specific Federal Public Lands, including National Parks, National Forests, and Recreation Areas.

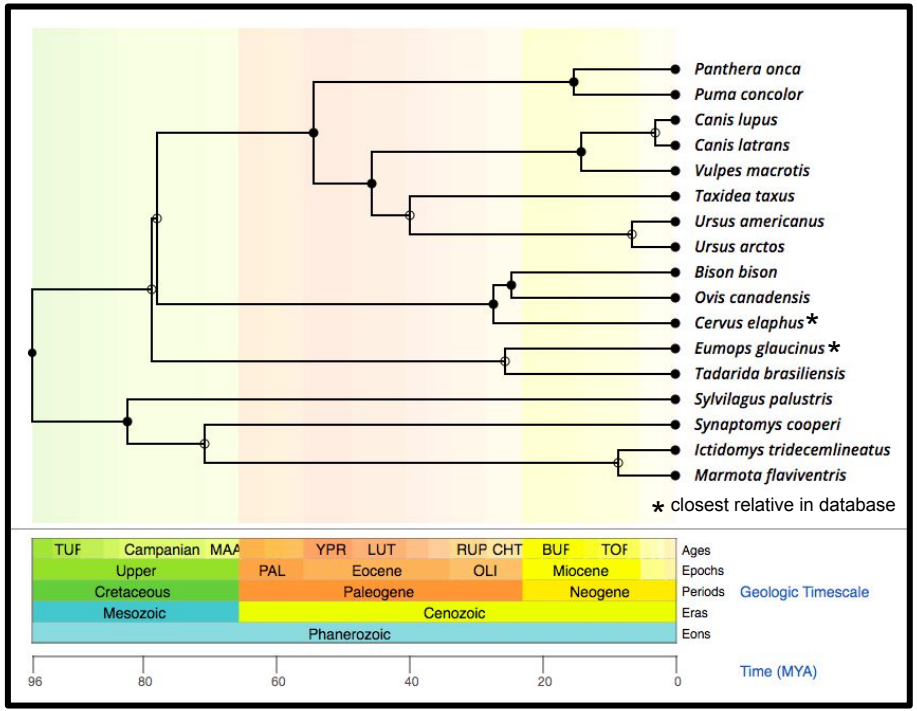
In this activity, students research the specific ecosystems of the combatant and the other mammal species in their ecosystem.



ECOSYSTEMS: Interactions, Energy, and Dynamics

	Scientific Term
CARNIVORES: cougars, wolves, coyotes, otters, badgers, bears, foxes, bobcats, weasels	**CARNIVORA**
HOOFED MAMMALS: elk, deer, bison, bighorn sheep, moose	**ARTIODACTYLA**
BUNNIES: rabbits, hares, pika	**LAGOMORPHIA**
RODENTS: mice, rats, beavers, marmots, squirrels, lemmings	**RODENTIA**

TimeTree.org Phylogeny of WILD North America Division 2022



Life Science Core Concepts sourced from the National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165. Image by K. Hinde at TimeTree.org

ECOSYSTEMS: Interactions, Energy, and Dynamics

Scientific Term	
CARNIVORA	**Large** bear, cougar, wolf, **Medium** coyote, otter, badger, fox, bobcat, raccoon, skunk, fisher **Small** weasel, stoat, ferret, mink, pine martin
ARTIODACTYLA*	**Extra Large** bison, moose **Large** elk, deer, bighorn sheep, mountain goat, pronghorn
LAGOMORPHIA	**Medium** rabbit, hare, cottontail **Small** pygmy rabbit, pika
RODENTIA	**Medium** beaver, marmot, porcupine, **Small** mice, rats, squirrels, woodrat, chipmunks, flying squirrel, voles

Bobcat with Ground Squirrel

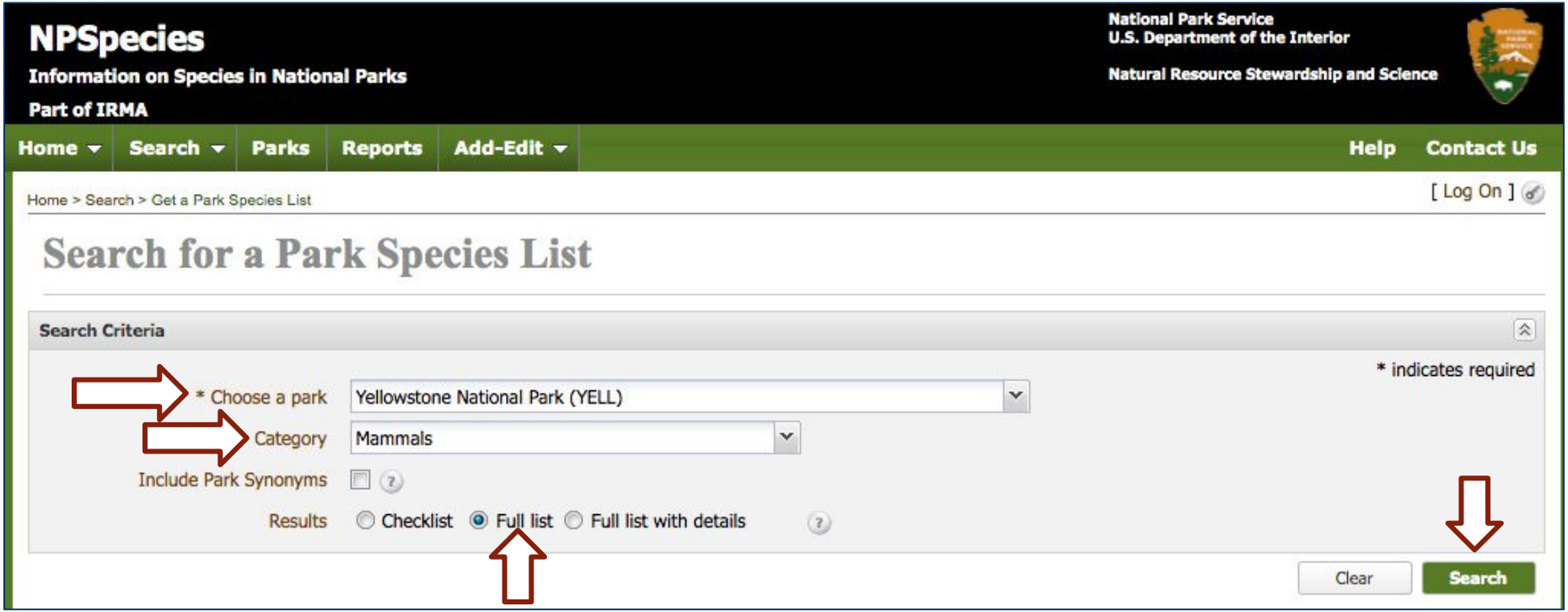
Ground Squirrel with Grass

*Hoofed Mammals are typically Large-Extra Large in North America

Top Image by Alan Schmierer
Bottom Image by Brocken Inaglory

ECOSYSTEMS: Interactions, Energy, and Dynamics

Ecosystems of 2022 March Mammal Madness Combatants in WILD North America



Website URL: https://irma.nps.gov/NPSpecies/Search/SpeciesList

ECOSYSTEMS: Interactions, Energy, and Dynamics

Ecosystems of 2022 March Mammal Madness Combatants in WILD North America

Results

Restore default sort order | sorted by Category Sort, Order, Family, and Scientific Name | Download | Report/PDF

ry	Order	Family	Scientific Name	Common Names	Record Status	Occurrence	Nativeness	Abundance
al	Artiodactyla	Antilocapridae	*Antilocapra americana*	antelope, pronghorn	Approved	Present	Native	Common
al	Artiodactyla	Bovidae	*Bison bison*	bison, buffalo	Approved	Present	Native	Abundant
al	Artiodactyla	Bovidae	*Oreamnos americanus*	mountain goat, Mountain Goat, Ro...	Approved	Present	Non-native	Uncommon
	Artiodactyla	Bovidae	*Ovis canadensis*	bighorn sheep, Bighorn Sheep	Approved	Present	Native	Uncommon
al	Artiodactyla	Cervidae	*Alces alces*	Eurasian Elk, moose	Approved	Present	Unknown	Uncommon
al	Artiodactyla	Cervidae	*Alces alces shirasi*	Yellowstone moose	Approved	Present	Native	Uncommon
al	Artiodactyla	Cervidae	*Cervus elaphus*	Rocky Mountain Elk	Approved	Present	Native	Abundant
al	Artiodactyla	Cervidae	*Odocoileus hemionus*	mule deer, Mule Deer	Approved	Present	Native	Abundant
al	Artiodactyla	Cervidae	*Odocoileus virginianus*	white-tailed deer, White-tailed Deer	Approved	Present	Unknown	Uncommon
	Carnivora	Canidae	*Canis latrans*	Coyote	Approved	Present	Native	Abundant
al	Carnivora	Canidae	*Canis lupus*	Gray Wolf, Wolf	Approved	Present	Native	Common
al	Carnivora	Canidae	*Vulpes vulpes*	Red Fox	Approved	Present	Unknown	Common
al	Carnivora	Felidae	*Lynx canadensis*	Canada lynx, Canadian Lynx, lynx	Approved	Present	Native	Rare
al	Carnivora	Felidae	*Lynx rufus*	Bobcat	Approved	Present	Native	Uncommon

Page 1 of 1 | Displaying 1 - 78 of 78

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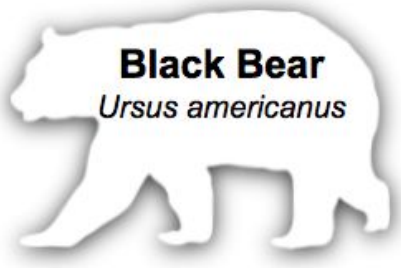
ECOSYSTEMS: Interactions, Energy, and Dynamics

Ecosystems of 2022 March Mammal Madness Combatants in WILD North America



Name_____
Date _____
Class_____
Teacher_____

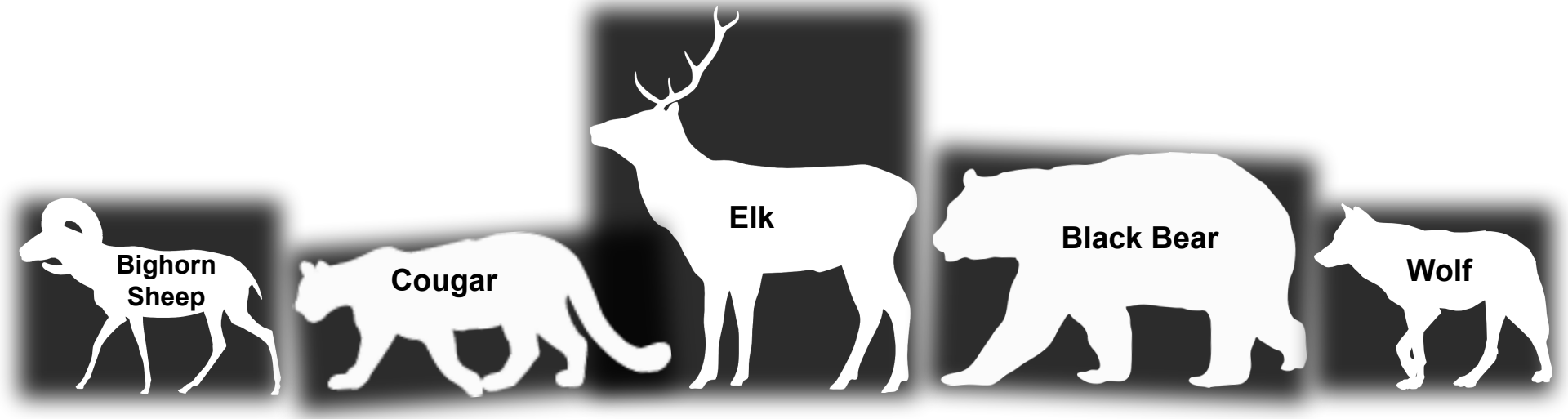
Hot Springs National Park

PRIMARY CONSUMERS			
Body Size	Small	Medium	Large/XL
Order	Rodentia	Lagomorph	Artiodactyla
Common Name			

SECONDARY, TERTIARY, & APEX CONSUMERS			
Body Size	Small	Medium	Large/XL
Order	Carnivora	Carnivora	Carnivora
Common Name			

Website URL: https://irma.nps.gov/NPSpecies/Search/SpeciesList

ECOSYSTEMS: Interactions, Energy, and Dynamics



March Mammal Madness Combatants & their Ecosystems!

Silhouettes from PhyloPic.org: Margot Michaud, Steven Traver, Skye M, Becky Barnes, Chloe Schmidt, An Ignorant Atheist CC BY 3.0

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ECOSYSTEMS: Interactions, Energy, and Dynamics

Additional Slides for Teachers if they expand the assignment

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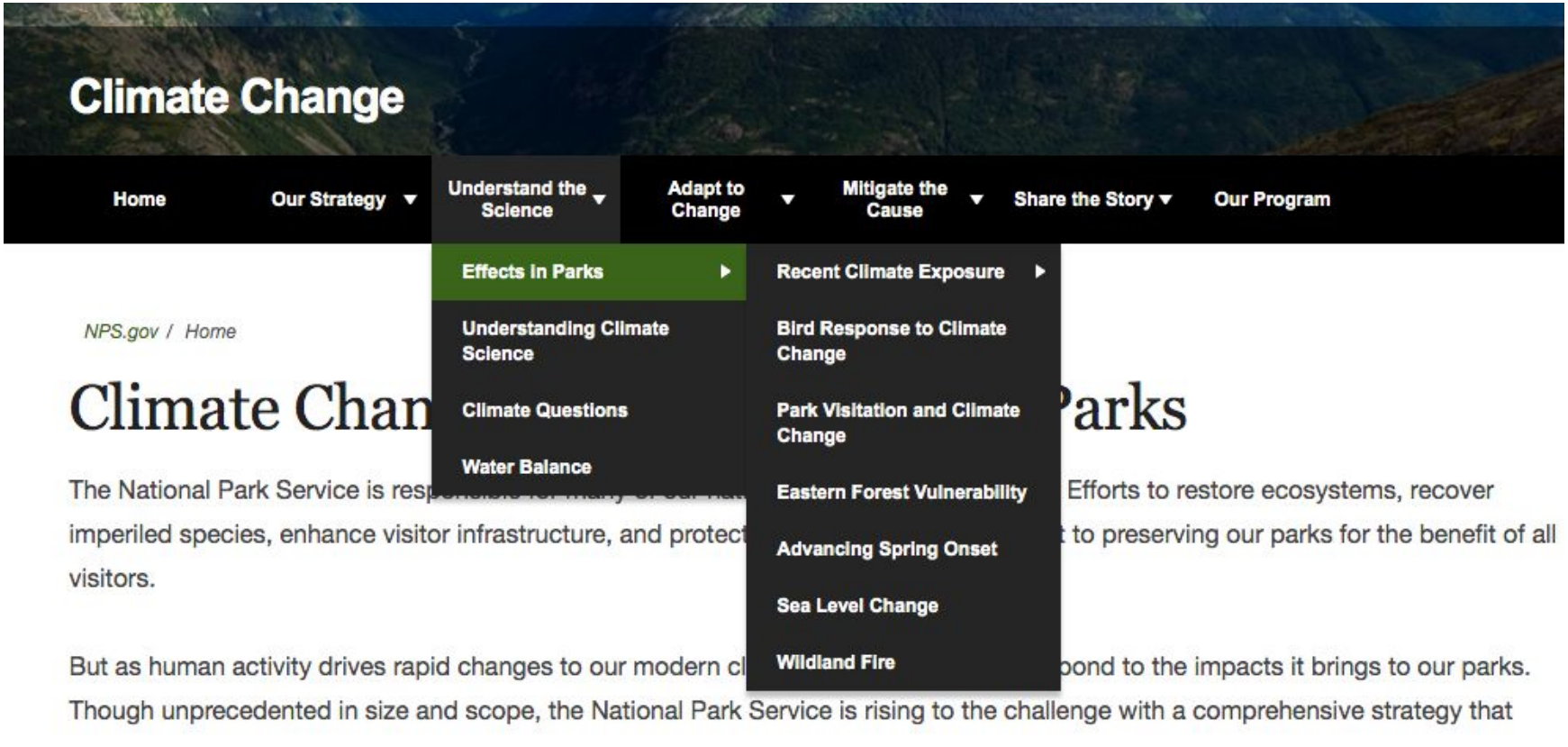
ECOSYSTEMS: Interactions, Energy, and Dynamics



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ECOSYSTEMS: Interactions, Energy, and Dynamics

“Traditional Ecological Knowledge (TEK) is the on-going accumulation of knowledge, practice and belief about relationships between living beings in a specific ecosystem that is acquired by Indigenous people over hundreds or thousands of years through direct contact with the environment, handed down through generations, and used for life-sustaining ways. This knowledge includes the relationships between people, plants, animals, natural phenomena, landscapes, and timing of events for activities such as hunting, fishing, trapping, agriculture, and forestry. It encompasses the world view of a people, which includes ecology, spirituality, human and animal relationships, and more. TEK is also called other names, such as Indigenous Knowledge and Native Science.”

www.nps.gov/subjects/tek/description