



My Own Biome Teachers' Guide

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Overview

My Own Biome is a four-player learning game played on Windows PC. In this game, each player controls a unique biome. The game is built on top of an artificial life simulation. This simulation runs automatically and controls the behavior of the thousands of plants and animals present in the game. It contains a sandbox mode, as well as single player and both local and network multiplayer modes.

In the game, players must reduce the pressures created by people living in the area by giving up part of their biome to satisfy their needs represented by: living space, farmland, industrial space, mining, and logging. However, each of these will have a variety of negative effects on the biome. Players must use a host of tools to keep the plant and animal populations stable despite these pressures. The task is to keep the biome healthy despite the pressures caused by people living in the area.

My Own Biome simulates ten biomes. These are listed below with the specific locality of the instance of that biome following in parentheses:

- Desert (Mongolia)
- Deccan Thorn Scrub Forest (India)
- Middle Latitude Deciduous Forest (New England)
- Taiga (Scandinavia)
- Temperate Coniferous Forest (California/Oregon)
- Temperate Grassland (Australia)
- Tropical Dry Forest (Peru)
- Tropical Grassland (Sudan Grass Belt)
- Tropical Rainforest (Brazilian Amazon)
- Tundra (Alaska)

The primary goal of My Own Biome is to educate its players about ecology and the conflict generated by human presence in the environment. Through playing this simulation game, players learn about organisms on the species level as well as the population level as they manage the land use in a biome. In particular, it will help teach:

- The names, types and nature of plants and animals found in each of the ten biomes
- The effect that the introduction of humans can have on an ecosystem
- Techniques used in wildlife and ecosystem management
- The importance of biodiversity and the consequences of the extinction of a species
- The food web
-

This tool is perfectly tailored to the needs of today's students. It will allow them to interactively experience the content while encouraging a fun learning environment.

Use and Caveats

My Own Biome should be viewed as an education tool similar to a textbook or lab exercise. It is not designed to serve as a replacement for traditional instruction. Instead it supports the curriculum by placing students in an environment where they can put to practice the knowledge gained from other parts of the course. At this point the students are able to use the simulation to draw conclusions and make decisions about balancing humanity's needs and those of nature.

It is very important to remember, and to clearly inform students, that My Own Biome is not a perfect simulation of real world environments. The game is constrained by limits in computer power and the need to provide an environment that students will be able to understand and interact with. As such, there is a fair amount of "normalization" and simplification present in the game. This includes the following:

Biodiversity

The number of plant and animal species is limited to a total of twelve in each biome. This number provides sufficient complexity to demonstrate major concepts without exceeding the capacity of current technology. It also presents students with environments that can be completely understood and mastered over the course of a semester.

Population Numbers and Scale

On current platforms, the simulation can manage a total of approximately four to six thousand individual plants and animals at any one time. While this gives it sufficient numbers to represent larger creatures, it creates a problem of scale with smaller ones. For example, a range of land that is large enough to be a home for twenty bears may contain twenty thousand mice. To resolve this problem, we increase the weight of smaller species while decreasing their numbers. This allows us to maintain a manageable number of plants and animals while preserving each species appropriate percentage of the total biomass in the environment.

As such, units are deliberately avoided when the weight of an animal is displayed.

Reproduction

In the natural world some animal species produce dozens or even hundreds of offspring per each act of reproduction. Trees often produce thousands of seeds per year. Of course, most of these plants and animals never reach adulthood.

As we are technologically unable to handle these numbers in the simulation, this process has been simplified. Animals aren't "born" into the game until after enough time has elapsed for them to have reached what can be approximated as "early adolescence." Plants follow a

similar system. In addition, the litter size has been reduced to the approximate number that would reach this stage of life.

Controls

The Xbox 360 Controller

This illustration names the controls afforded to the player. In each game, these controls are designated for special functionality. Below is the mapping of the controls for the My Own Biome game.

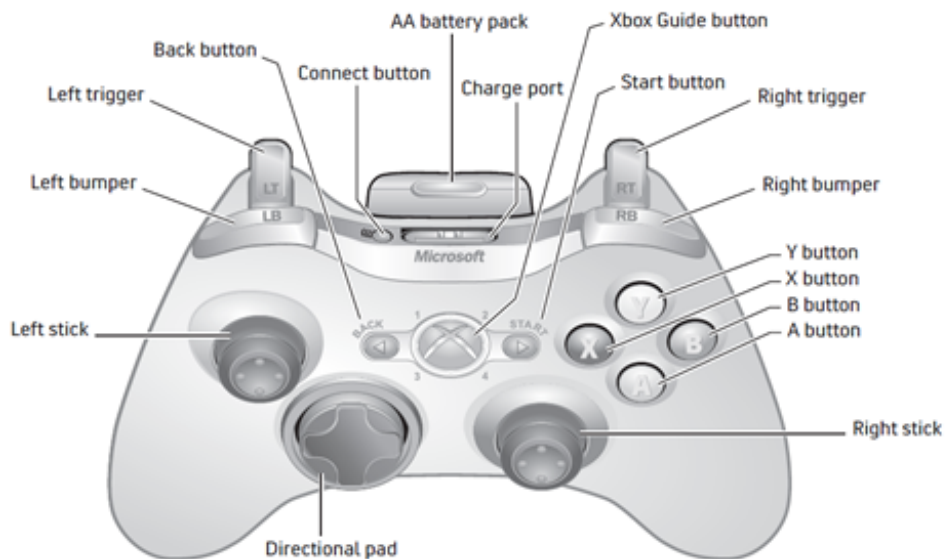
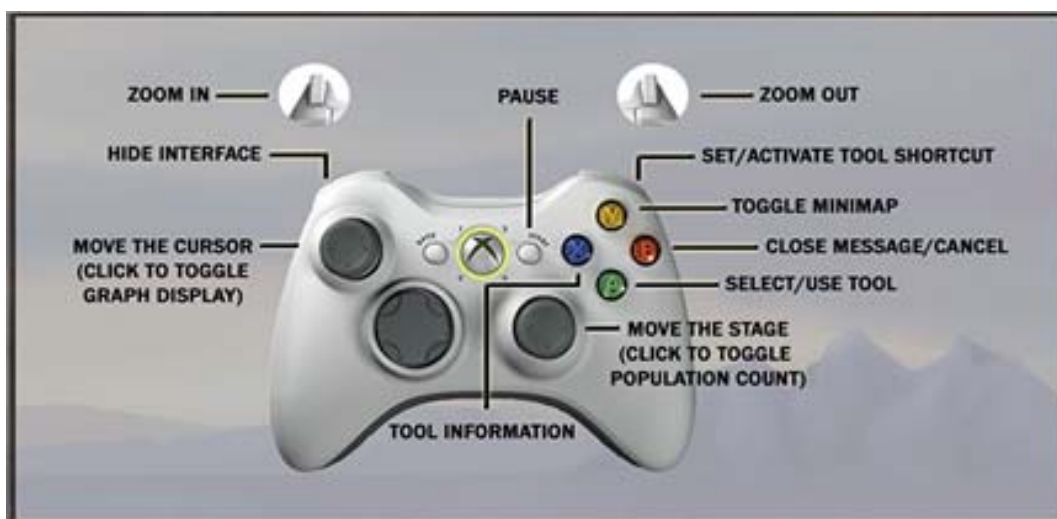


Image from Microsoft.com

In-game options



Mouse and Keyboard Control

The mouse and keyboard can be used for single player mode, sandbox, and as an alternate to the controller for the first player in multiplayer mode. However, multiplayer mode will still require a minimum of two Xbox 360 controllers.



Learning about Biomes

Each biome may be investigated using the Sandbox. The Sandbox is a single-player game mode in which the selected biome uses the entire screen. Students will be able to identify the various plants and animals that inhabit each biome. Interactions are permitted and students may apply human intervention in this format. However, human needs are not present in sandbox mode and the player has unlimited funds to work with.



To begin Sandbox mode:

- At the Hello screen, use the controller to select Play and press A or use the mouse to click Play.
- Move the cursor down to New Sandbox using the left thumb stick. Press A. Alternately, click New Sandbox with the mouse
- The New Sandbox Game options menu appears.
- Use the left thumb stick to move the cursor to select options. Press A to activate the selection. The mouse may be used as well. Click options to activate them.
- First choose a specific biome to study. The default selections will provide a balanced biome lacking human intervention.
- To modify the species defaults, align the cursor to the desired option number. Press A. Move the left thumb stick right and left to decrease or increase the number of species. Press A to select that number. The keyboard and/or mouse can be used for this function as well. Click or press enter on the desired option number to select it. Use the up and down arrow keys or the mouse-wheel to adjust the number. Click or press enter again to select that number.
- To modify the species types present in the biome, move the left thumb stick to a species slot under the *Species Selection* heading. Press A to open a selection menu. Press A again to select the biome the desired species is found in, whether it is a plant or animal, and finally the species itself. The selection window can also be operated using the arrow keys and enter button as well as using the mouse.

- ## The Sandbox



The left thumb stick, or mouse, controls the cursor.

The right thumb stick controls the view port window for the player. Moving the cursor to the edge of the window will also move the viewport.

Use the left and right triggers to zoom in and out.

The MiniMap:



Press the Y button, or M on the keyboard, to view the mini map. This shows the player where the viewport is looking and where the species are located.

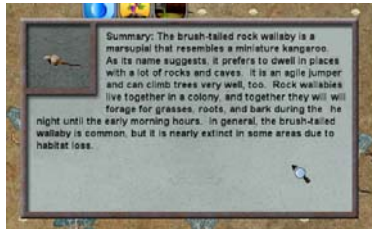
The shaded rectangle indicates the view port window. The colored squares indicate the location of specific species or human constructs such as housing. The cloud outside the mini map indicates that it is raining in the biome. The species do not display while the

simulation is in the mini map mode.

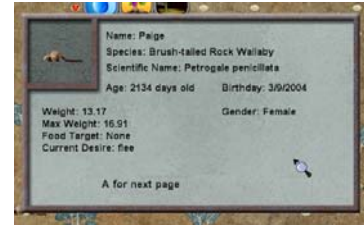
Press the Y button, or M on the keyboard, to restore the view to the sandbox.

The Species Information Window

With the Species Information tool selected (magnifying glass cursor), use the left thumb stick or mouse to move the cursor over a species. Press A or click the Left Mouse Button. An information window will pop open. The first screen displays information directly related to the simulation.



Press A or click again to view the second screen. This screen displays a summary of real world information about the plant or animal selected.



Press B or click outside the window to hide the information screen.

Overview of the game

The gameplay of My Own Biome is built on top of the simulation that controls the interactions between the species of the Biomes. Each player is given control of a single distinct and separate biome. As such, each game will be very different from the one before it and will teach new lessons while reinforcing those already learned. The simulation runs automatically and would continue perpetually if the game did not add outside interference.

The outside interference is caused by two factors. The first is a game mechanic that controls the five needs of people living in the area; living space, farming space, industry space, mineral production, and logging. Each of these removes usable land from the biome.

The second outside interference is the actions of the players. Ideally, these actions will help to keep the biomes in a stable state despite the pressure from the human element. However, incorrect actions by the players, such as increasing the number of predators too high, can unbalance and destroy a biome quickly.

Length of Time Play

A game will last between 15 and 45 minutes, depending on the game settings and skills of the individual players. At the beginning of the game, either a short game (15 minutes), long game (30 minutes), or extended game (45 minutes) is chosen. However, a game can last shorter than these time settings under certain conditions.

Grading

Throughout the game, the player will receive a grade that represents their performance level up to the current point. This will be presented as a standard percentage of perfect. Players will start at a perfect score and lose points for time spent with plant or animal species in vulnerable,

threatened, or extinct states. At the end of the game, players will be presented with a summary screen that lists their final grade (A-E) and the number of extinctions suffered by their biome.

Victory Conditions

The game will be considered a victory if it ends with all players having less than six extinctions in their biomes. All players will receive complete scores without any modifiers. Additionally, all players will receive a full letter grade bonus to their grade if all players were able to complete their game without any extinction.

Loss Conditions

If more than half of the total number of species in all biomes goes extinct, the game will immediately end in a loss. All players will have their final grade reduced by 50 percent.

At the end of the game, if any one player has more than six species go extinct, the game will be considered a loss and all players will have their final grade reduced by 25 percent.

Beginning a New Game

Local Game

- At the Hello screen, select Play and press A with the controller or click Play with the mouse.
- Press A to select Local Game or click with the mouse.
- The New Game options menu appears.
- Use the left thumb stick to move the cursor to select options. Press A to activate the selection. The mouse and/or keyboard can be used as well.
- Press Start on the controller, Enter on the keyboard, or click the start button with the mouse to begin.

Network LAN Game

Multiplayer games can now be played via computers on the same Local Area Network (LAN). To begin a LAN Game:

- At the Hello screen, select Play and press A with the controller or click Play with the mouse.
- Press A to select Local Game or click with the mouse.
- To create a new game, select Create Game. The lobby screen will open and the game will be available for other players to join.

- To join an existing game, select Join Game. This will display a list of available games in the Find a Game screen. Select the desired game from the list to the left, then press A or click Join Game to join the game listed in the Selected Game box.
- Once the desired players are in the lobby, the Host can press A or click the Start Game button to move to the setup screen.
- Once in the setup screen, all players must indicate that they are ready before the host can begin the game.

Options are as follows:

- Player 1-4: Select a biome for this player. Random will pick one from the list. Note that only one player can be in a menu at a time.
- Water Cycle: Turn the water cycle on or off. If on, plants must draw a certain amount of water from the ground to survive. Both the amount of water required and the area it is drawn from are based on the size of the plant. If off, plants will not die from lack of water.
- Nutrient Cycle: Turn the nutrient cycle on or off. If on, plants must draw a certain amount of nutrients from the ground to survive and grow. Both the amount of nutrients required and the area it is drawn from are based on the size of the plant. If off, plants will not die from lack of nutrients.
- Pollution: If on, human tiles will generate pollution tiles over time. These tiles kill plants and animals and are of no benefit to the player. This option can significantly increase the difficulty of the game.
- Poaching: Poachers enter the biome at random intervals and illegally hunt and remove animals. They are of no benefit to the player and can have a tremendous negative impact on the biome. This option can significantly increase the difficulty of the game.
- Invasive Species: If this option is on, the game will periodically introduce a small number of a non-native species to the biome. While these species do not count directly against the players' performance, they can severely disrupt the biome and displace native species. This option can significantly increase the difficulty of the game.
- Cryptozoology: Checking this option will introduce a small population of the mythical creature *El Chupacabra* to all four biomes. This will severely disrupt the biome. This option should only be used to demonstrate the impact that a legendary creature would have on an environment. It is not intended for regular gameplay.
- Game Length: Select a 15, 30, or 45 minute game.
- Human Needs: Select the rate at which human needs increase. This will alter the difficulty of the game. It will also scale the effect of other options.

Press Start on any controller, or click Start with the mouse, to begin the game. In a LAN game, all players must indicate that they are ready by pressing Start or clicking the ready button before the Host can begin the game.

In local games, the game screen is divided into four quadrants. Player One is in the upper left; Player Two the upper right; Player Three the lower left; Player Four the lower right.

In LAN games, each player uses the entirety of their screen. The names, biomes, and grades of the other players will be displayed at the bottom of the screen.

Human Needs

The major conflict in My Own Biome is caused by the needs of people living in the area. They require space and water, and generate pollution. Human needs are represented by the five bar graphs in the middle of the interface. From left to right they are living space, farmland, industrial space, mining, and logging. Each graph represents the need on a scale of 0 to 100.

Living space and farmland requirements increase constantly, by one unit per second for housing and 2 units per second for farming. The other three requirements increase when land is designated as either farmland or housing in any of the four biomes. A housing square cause the industrial space to go up by .1, mining by .1 and logging by .5. A farming square causes industrial to go up by .5, mining to go up .1, and logging to go up .25.

Players must use the tools on the toolbar to “paint” squares on their biome. Each tile painted will lower the need bar by one, with the exception of the logging tile. Additional options are available with special actions. Tiles can be painted with the following designations:

- Housing
 - Destroys all plants animals on contact
 - Reduces water up to 1 tile away by 1 unit every 10 seconds
 - Increases pollution at a low rate



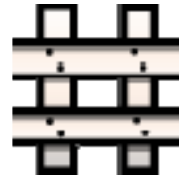
- Farming
 - Destroys all plants and animals on contact
 - Reduces water up to 3 tiles away by 3 to 1 unit every 10 seconds
 - Increases pollution at a moderate rate



- Industry
 - Destroys all plants and animals on contact
 - Reduces water up to 3 tiles away by 3 to 1 unit every 10 seconds
 - Increases pollution at a high rate
- Mining
 - Destroys all plants and animals on contact
 - Reduces water up to 3 tiles away by 3 to 1 unit every 10 seconds
 - Increases pollution at an extremely high rate
- Logging
 - One in ten chance of killing animals and small plants present each turn, modified by max weight
 - Creates a logging truck that will seek out and harvest trees that are large enough and of an appropriate type. The logging truck will kill any plant or animal it runs over and will destroy fences.
- Nature Preserve
 - Destroys poachers on contact
 - Gives player 1 PC for each plant or animal present every 10 seconds
 - Prevents land from being taken via punishment
- Hunting Park
 - 1 in 10 chance every 10 seconds to convert a poacher to a hunter (destroy it).
 - 1 in 10 chance each turn to destroy each animal on hunting park per turn
 - Gives player PC based on the size of each animal hunted



- Fence
 - Prevents animals from crossing
 - Will be destroyed by poachers



Punishment

If the four players allow any of the needs graphs to reach 100 by refusing to give up enough of their biomes, then a punishment occurs. One of the four players will be selected at random and 48 random tiles of their biome will be assigned to fulfill the need. However, the graph and its associated need will only be reduced by 24.

Player Interaction

Political Capital

My Own Biome will use a currency called Political Capital (PC). This represents the money, legislative action, legal action, and lobbying required to accomplish a goal in the real world. Different actions will give the player PC, or require them to spend it.

Players will interact with their biomes via a mouse cursor on screen and a toolbar. The toolbar will have the following tools. Cost/reward in Political Capital is indicated in parentheses:

Painting Tools

- Paint House (+15)
- Paint Farming (+20)
- Paint Industry (+30)
- Paint Mining (+40)
- Paint Logging (+20)
- Paint Nature Preserve (-100)
- Paint Hunting Park (-50)
- Paint Fence (-2)

Animal Interactions

- Info – Get info on chosen plant or animal
- Cull (-5) – Destroys target plant or animal
- Breed (*) – Releases ten of target plant or animal into the wild via a captive breeding program. Cost is based on the size of the plant or animal. They will be released into the world at random locations.
- Capture -(*) – Based on the size of the plant or animal

- Trade – Allows the player to give a captured animal to another. A hardware limitation caps the amount of different species that can be present in any one biome. This varies per machine and per biome. This feature is currently disabled for LAN games.

Other

- Clean Pollution (-10) – Removes the selected pollution tile
- Irrigate (-10) – Increases the water level of a 3x3 area
- Fertilize (-10) – Increases the nutrient level of a 3x3 area
- Bulldozer (*) – Reverts a tile to being unpainted. The cost is twice the absolute value of the initial cost.



Gameplay & Mechanics - *Simulation*

World

The world in each game of My Own Biome will consist of four separate biomes. Each of these biomes will consist of a 64x64 grid of tiles. This gives a total area of 4096 squares. Each square will have the following properties:

- Position – the location on the grid
- Soil Nutrients – How rich the soil is for plant growth
- Water – How much moisture is currently present in the soil

Soil nutrients and water are dynamic variables and change according to a number of factors.

Soil Nutrients are depleted by a plant living on the square where the nutrients are found. They are increased when a plant or animal dies on or near a given square. It can also be increased by the use of the fertilize tool by the player.

Water is depleted by plants living on the tile. It is also depleted by the presence of nearby housing tiles, industrial tiles, farming tiles, and mining tiles. It is increased by rain and by the use of the irrigate tool by the player.

The size, frequency, and quantity of rain clouds are determined by the water needs of a balanced biome. Plants pull water from the soil which is then placed in a rain cloud. When this cloud reaches a certain percentage of the biome's total water level, a cloud will be generated. The size of this cloud will be the size needed to accomplish relatively standard distribution for the water. As a result, clouds in the desert are small and infrequent while clouds in the rainforest are large and frequent. Please note that weather simulation is not a focus of My Own Biome. As such, the water cycle is greatly simplified.

Pollution

If pollution is active, each human tile generates a certain amount of pollution, with housing generating the least and mining generating the most. As the amount of pollution generated increases, pollution tiles will begin appearing in the biome. Like other human tiles, these will kill any plant or animal found at the location. However, they are of no benefit to the player. Pollution tiles can be cleaned with the Clean Pollution tool.

Poaching

If the poaching option is active, the game will periodically introduce poachers into the biomes. Poachers hunt and kill animals and remove their bodies from the biome. Poachers also leave the biome if they decide to become legitimate hunters due to a sufficient availability of Hunting Parks, or are arrested after entering a Nature Preserve

Invasive Species

There is a 1 in 100 chance per biome every 10 seconds that a random species from another biome will invade. In this occurrence, a group of 10 of the invasive species will be placed in the chosen biome. Invasive species do not count directly against the player's score. However, they can displace legitimate plants and animals from their niche.

Plants

Each plant object will store and be affected by the following values:

- Type – Species of plant
- Location
- Nutrient Level – The amount of nutrients a plant will pull each turn from each tile it can reach
- Water Level – The amount of water a plant will pull each turn from each tile it can reach
- Water used per turn. Equal to max weight times unique decimal multiplier
- Age
- Max Age – The age at which the plant dies of old age
- Current Weight
- Max Weight
- Penultimate weight – Maximum max weight
- Reproduction range – How far new seedlings can be placed
- Food Type – Used to determine what animals will eat from it
- Structure Type – Used to determine what animals will eat from it

Plants can pull nutrients and water from the tile they occupy and farther tiles as Max Weight increases. Each turn, they draw their nutrient level from each square they can reach. Nutrients are added to the plant's current weight. Any overage is added to the plants Max Weight. Water is considered returned to the atmosphere and moves to a rain cloud. If a square does not contain the required water or nutrients, the plant will take all found in the tiles it can reach.

If the plant is unable to draw 75% of the ideal amount of water, it will not draw nutrients from the soil and will not grow. If it is unable to draw water for five turns, it dies of dehydration.

If a plants max weight has reached its penultimate weight, it will only draw nutrients from the soil if its current weight is less than its max weight. It will continue to draw water as normal.

Plants in My Own Biome will not be divided into genders because pollination techniques will not be a focus of this game. Instead, plants reproduce automatically according to their reproduction season. Seedlings will be placed at randomly chosen tiles around the parent plant within the reproduction range. If a plant already exists on a chosen tile, that seedling will die. Seedlings begin with their current and max weight at 20% of the penultimate weight. If this amount cannot be pulled from the soil, the seedling will die.

Plants die if their current weight drops below 30% of the max weight. If a plant dies, whether from being eaten, old age, or too little water or nutrients, its current weight is added to the nutrient level of the soil as according to a standard distribution algorithm.

Animals

Animals always have one of the following desires. These desires determine the behavior of the animal:

- Hunt Food: Check surrounding area for suitable prey. Move to new hunting ground if none found
- Find Mate: Check surrounding area for suitable mate. Move to new area if none found
- Wander: Default state. Move around randomly
- Flee: Move at sprint speed away from a defeated/evaded predator until it is caught or the predator stops chasing it.
- Stalking: Predator sneaks up on prey while checking to see if it has been perceived.
- Chase: Predator runs directly towards prey at sprint speed until it catches it, loses perception of it, or gives up.

Each animal object will store and be affected by the following values:

- Type – Species of animal
- Name – The animals name given at birth. Names serve to help players distinguish between different members of the same species
- Food Type – Carnivore, omnivore, or herbivore
- Location
- Cruise Speed – How fast the animal moves normally
- Chase Speed – How fast the animal moves to evade an predator or catch prey
- Predator Skill – How skilled an animal is at killing its prey once it is in range
- Prey Skill – How skilled an animal is at avoiding being killed and eaten by a predator that is able to get within striking distance
- Perception Range – The distance that an animal can see, hear, or smell food or mates. In a scale of 1 to 25 tiles
- Stealth – How hard the animal is to detect when hunting another animal.
- Age – Animals reach sexual maturity at 1/3 their max age
- Max Age – The age at which the animal dies of old age
- Current Weight – Animals become hungry and will seek food when their current weight is less than 80% of their current weight. They die of starvation when their current weight is less than 15% of max.
- Max Weight – Max weight of the animal at its current growth level. Increases as the animal ages, reaching penultimate at half its age.
- Penultimate Weight – Maximum Max Weight.
- Mating Season – What time of the year the animal will attempt to reproduce.
- Reproduction Quantity – Litter size

- Reproduction Time – How long the animal stays pregnant before delivering plus how long it takes the resulting animals to reach young adulthood.
- Max Weight Eatable: The maximum weight of an animal the animal will attempt to kill and eat. Expressed as a percentage of the animals current weight.
- Exclusion List – List of specific species in the game the animal will not attempt to eat
- Scavenger – Whether or not the animal will eat already dead prey
- Omnivore Preference – Plants or animals

Hunting/Combat

Hunger

Animals will become hungry when their current weight falls to 80% of their max weight. However, the desire to mate will trump hunger until the animal falls to 65% of its max weight.

Food Selection

When an animal becomes hungry it will look around itself up to its perception range to select a food target. This selection works as follows according to animal type:

- Herbivores choose the closest plant that is of a structure type OR food type that they can eat.
- Carnivores select prey based on a value system that considers distance, chance of catching the prey, chance of killing the prey, danger the prey presents, and the weight of the prey.
- Omnivores seek food based on preference. Meat-preferring omnivores will act as carnivores, then as herbivores if a suitable prey animal is not found. Plant-preferring omnivores do the opposite.

If no suitable targets are found, the animal will move in a random direction for five turns before looking for a target again.

If the chosen target is a plant, the animal will move towards the plant at its normal movement rate and will eat from it when it gets there. Mechanically, the animal will take weight from the plant up to the animal's max weight. If this number is higher than the plant's current weight, then only the current weight will be taken.

If the chosen target is another animal, the predator will enter stalk mode. It will move directly towards the animal at its normal movement speed. If the predator's stalk distance is higher than the prey's perception distance then the prey will have a chance to detect the predator as soon as it enters the prey's perception distance. If the predator's stalk distance is lower than the prey's perception distance then the prey will have a chance to detect the predator after it reaches the average of the two distances.

Once the predator is within the detection range, the prey will have a chance each turn to detect the predator based on a ratio between the perception range of the prey and stealth of the predator. If the predator is detected, the prey will enter the flee state and the predator will enter the chase state. A fleeing animal will move in a random direction at its chase speed for five turns, then pick a new direction at random (excluding the opposite of the current direction) and move in that direction for five turns. The predator will move directly towards the prey animal until it reaches it, or the animal goes beyond its perception range.

When a stalking or chasing animal moves on to a tile with an eligible prey animal a combat situation occurs. In this instance, a random number is generated between 1 and predator skill plus prey skill. If that number is less than the predator skill, the predator has successfully killed the prey. Whichever animal has a higher total wins. If the attacker wins, the prey animal is killed. The predator takes all of the weight from the prey animal up to 90% of the animal's current weight. After several days, any leftover weight is distributed to the soil via the same mechanism used when a plant dies.

If the prey animal wins, it immediately moves away at its chase speed and is placed in the flee state and the chase will continue as described above. The predator loses one movement turn while it recovers.

Scavenging

Any time an animal dies and is not fully eaten, its corpse will lay on the ground for several days before returning to the soil. During this period, it is available as food for scavenging animals.

Movement Cost

Each movement undertaken by an animal will use a set percentage of their maximum weight as follows:

- Movement: .25% each tile
- Fast Movement: .5% each tile

The weight used for actions will be stored in an excretion variable. When this reaches 10% of the animals max weight, this mass is passed into the soil using the same method described in the section on plant death.

Breeding

Animals will have genders in My Own Biome. At birth they will be designated as male or female. Reproduction will require that a male and female who are ready to mate to find each other. When they find each other, the female will become pregnant. After becoming pregnant, the mother will attempt to eat enough food to fill an infancy "bucket". The size of the bucket is her species litter size times her penultimate weight divided by four. This represents the

additional nutrient requirements, and thus food sought out, while the mother is pregnant AND while she is nursing and weaning her offspring. After her term (in the game this is the time from when she becomes pregnant until the time her offspring are independent), the young are created next to her. While there is still food in the bucket, each young in the litter is created at full health (max and current weight at $\frac{1}{4}$ of penultimate). If the bucket is not full, when there is not enough left in it to create a full weight animal, a runt will be created instead. It is possible that this runt will have so little weight it will immediately die. All remaining animals in the litter will not be created.

Animals who are hungry will attempt to breed unless their current weight falls to less than 65% of their max weight. Animals that are pregnant will fill the infancy bucket before eating for themselves unless their weight falls below 65%.

Animals that are currently in their mating season as according to the game clock will be placed into the breeding state until they become pregnant, hungry or the breeding season ends. Mating seasons will be defined in months as according to the game calendar which works as follows:

- 30 minutes of real time is equal to 15 years of game time (a year is equal to 360 days and a month is equal to 30 days to simplify game calculations.)
- 1 minute is equal to 180 days
- 1 second is equal to 3 days
- 20 cycles, or $\frac{1}{3}$ second, is equal to 1 day.

Old Age

When an animal reaches its maximum age, it will die and after a few days during which it is available to scavengers its weight will be distributed to the soil as described above.

Data

My Own Biome will record a tremendous amount of data during the game. This data will be available to players and teachers via the graphs function for each player's biome. At the end of a game, the players will be given the option to save the game data for future viewing using the Graph Viewer. Available graphs include:

- Species Population
 - The population over time of each species in the biome.
- Population Delta
 - The rate of change of each species' population over time.
- Species Avg. Weight
 - The average weight of all members of each species.
- Average Weight Delta
 - The rate of change of average weights for each species
- Player Statistics
 - Total number of each tile painted over time
 - The amount of irrigation and fertilization performed by the player
 - The number of pollution tiles cleaned
 - The player's score
- Overview Statistics
 - The total number of tiles given over to human use
 - The total number of animals killed by poachers
 - The total number of plants in the biome
 - The total number of animals in the biome

When viewing a graph, mousing over a label will cause that item to be highlighted and the current number will be displayed. To show or hide an item, click on its label.

The Biomes

My Own Biome simulates ten biomes. These are listed below with the specific locality of the instance of that biome following in parentheses:

- Desert (Mongolia)
- Deccan Thorn Scrub Forest (India)
- Middle Latitude Deciduous Forest (New England)
- Taiga (Scandinavia)
- Temperate Coniferous Forest (California/Oregon)
- Temperate Grassland (Australia)
- Tropical Dry Forest (Peru)
- Tropical Grassland (Sudan Grass Belt)
- Tropical Rainforest (Brazilian Amazon)
- Tundra (Alaska)

Desert (Mongolia)

The Gobi Desert covers a large region of Mongolia and China. Unlike a typical hot desert, the cold Gobi is dry because the Himalayan Mountains create a barrier for rain clouds. It also sits on a plateau at three- to five-thousand feet above sea level. Many species exist on this desert and surrounding biomes, including gazelles, polecats, camels, wolves, shrubs and the extremely rare snow leopard. Originally, neighboring forests and grasslands create a boundary for the desert, but deforestation and overgrazing is allowing the Gobi to expand at more than 1,300 square miles per year.



Species:



Bean Caper

Zygophyllum xanthoxylum

Known as a noxious weed in Washington and California where it has been introduced, the bean caper is an undesirable plant that has spread beyond cultivated gardens with negative results. This waxy, perennial shrub grows in dense masses that replace beneficial native plants. It is difficult to remove because its roots grow deep, and remaining roots will grow into new plants. However, in the Mediterranean region where it originates, the small, pungent, gray-green flower buds are pickled and used in cuisines.



Bind Weed

Convolvulus ammanii

Bind weed is an herbaceous, perennial species of bind-weed that grows in the desert-like habitats of central Asia and Siberia. The plant grows very low to the ground, spreading out in a circular arrangement with funnel-shaped, pinkish-white flowers blooming at the rim. The stems are simple and the leaves are very small, only 1-4 mm wide. It does

extremely well in over-grazed areas with lots of debris, pebbles, and sand. Even though it is poisonous, it is good forage for goats and sheep in the summer.



Chinese Desert Cat

Felis bieti

The Chinese desert cat is not restricted to desert habitats, but is also found in steppes and brush. It is the only feline that is exclusive to China. This wild cat is larger and more robust than a domestic cat, with a face that is broader, rounder and framed by tufted ears. The coat is tan with black spots. The Chinese desert cat is rarely seen because there are few of them. Also, it is nocturnal since its prey (mice, voles, and pika) are active from dusk till dawn.



Field Wormwood

Artemisia campestris

The field wormwood is a member of the daisy family, but instead of blossoms, it produces small reddish-brown, flower-like florets along the upper tips of each stem. There are many vertical branches that grow in a tight bunch. Its leaves are small and parted with narrow bristles branching from the midrib. This herbaceous perennial grows in dry meadows, sandy seashores, cliffs, and also commonly sprouts along roadsides and railway tracks. In some places, the field wormwood is endangered or even locally extinct, while in other places it is considered a noxious weed.



Gobi Bear

Ursus arctos gobiensis

One of the most endangered animals, with only 50 individuals in the world, the Gobi bear is a subspecies of the brown bear that is exclusively found in the Gobi Desert of Mongolia. It is distinguished by its longer legs and shorter golden coat. The small population of Gobi bears makes them susceptible to any unnatural threats. Generally, it is shy and elusive, therefore not much is known about the bears. Mongolian scientists are researching the Gobi bear's behavior in hopes of learning more about it to inform conservation programs.



Gobi Jerboa

Allactaga bullata

The Gobi jerboa is a unique species of rodent that lives in the Gobi desert of Mongolia and China. They are unusual in appearance, having large hind legs like those of a kangaroo, a pig-like snout, extremely large ears and a very long tail that ends in a tuft. It is nocturnal and prefers to remain in its burrow during the day. At night, it will look for seeds and insects to eat. It is endangered because of habitat disturbance from mining, agriculture, and possibly climate change.



Gobi Wolf

Canis lupus Linnaeus

The Gobi wolf is a geographically distinct gray wolf that has adapted to the mountainous steppe habitats of the Gobi desert. Its natural prey includes tahki, deer, wild boar, camel, ibex, hare, and other herbivores. However, with more human settlement on its habitat, this wolf more often preys on domestic animals. Even so, the Gobi wolf is a favorite animal for the people of Mongolia, with folklore that tells of humankind's descent from wolves.

Coexistence of people and wolf of the Gobi is an important issue because both share nomadic lifestyles that rely heavily on grazing animals.



Gray Sagebrush

Artemisia xerophytes

The gray sagebrush has a strong, pungent fragrance that resembles that of the common sage. However, it is not related to the herb and is rather bitter in taste. This hardy plant can survive in the rough, arid climate of the Gobi desert and grows as a shrub or small tree with silvery-grey, wedge-shaped leaves up to 4 cm long. Along with the saxaul tree and saltwort, the gray sagebrush is an important component of one the Gobi, one of Asia's largest ecosystems.



Gray Sparrow's Saltwort

Salsola passerina

The sparrow's saltwort is a species of the genus *Salsola*, which includes herbs, shrubs, and small trees that tolerate often dry and somewhat salty soils. It is found in the steppe regions bordering the Eastern Gobi Desert. This grassland habitat is dominated by *Caragana* shrubs and low grasses. The saltwort is one of the vegetation that supports the diverse Gobi wildlife, which includes several species of jerboa, birds like sandgrouse and desert finch, and Saiga antelope. Natural steppes are being lost as people are plowing the land to grow crops and digging for oil.



Ibex

Capra sibirica

The ibex has special hooves with sharp edges and a concave center that allows it to grip small rocky surfaces with a suction-cup effect. It is an excellent athlete that can navigate among precipitous cliffs of Mongolian and central Asian mountains. Living in such a remote environment, it relies on grass, shrubs, and lichen for food. Males grow slightly curved horns that measure over two feet long, which creates a threat for this wild mountain goat because poachers and trophy hunters prize the horns.



Saxaul

Haloxylon ammodendron

In the dry, sandy ecosystem that is constantly altered by winds, the saxaul tree plays an important role by stabilizing habitats. Many saxaul trees grow together in the same area and cover a total of 11 million acres in southern Mongolia. It typically grows between 6-12 feet tall and has very few leaves, but the trees prevent soil erosion, serve as a barrier for sandstorms, and provide water because its bark retains water. Saxaul trees are increasingly used for firewood as coal prices increase, and alternative fuel sources are urgently needed to reduce the use of this important desert shrub.



Takhi

Equus ferus przewalskii

The takhi, also known as Przewalski's horse, is the last true wild horse that is related to the domestic breeds. It is identifiable as a stocky, golden-brown horse with a cream-colored belly and black feet. Takhi became extinct in wild during the late 1960s, but now there are over 60 takhis in the wild. All of the takhi in the Gobi today are descendents of thirteen individuals that were living in zoos.

Deccan Thorn Scrub Forest (India)

The desert scrub is an important biome that supports a surprising amount of plants and animals. Total rainfall for a year averages less than 10 inches, but a wet season promotes growth of plants like cactus, palm, and shrubs throughout the spring. Plants and animals that live on desert scrub have special adaptations to help them survive in the dry, hot climate. Plants have tough, waxy coating on the leaves to prevent water loss and taproots that grow deep to reach ground water. Animals require very little drinking water, but instead have ways to retain water in the body.



Species:



Asian Elephant

Elephas maximus

The Asian elephant has been part of human cultures since the Bronze Age, around 2,000 B.C. This highly intelligent pachyderm has been domesticated and can be trained to assist people in many activities, like transportation and heavy lifting. In the wild, Asian elephants are endangered due to habitat loss. Sometimes there is conflict between people and elephants when these large herbivores enter farmland and make crops a part of their daily dietary need - about 10% of their body weight!



Asiatic Long-tailed Climbing Mouse

Vandeleuria oleracea

The Asiatic long-tailed climbing mouse is widely distributed throughout India, China, and other countries in Southeast Asia. It may represent several similar species of mice that inhabit deciduous forests with bamboo and fields of tall canes. Compared to typical mice, the climbing mouse is arboreal, which means that it prefers spending time in plants or trees. Its long, stiff tail is an adaptation to maximize balance when climbing. It is considered a vermin in

some area, but ecologically, it is an important prey for other Asian animals, like owls and snakes.



Assyrian Plum

Cordia myxa

The assyrian plum is a perennial shrub native to India and the Mediterranean. It is also called the 'bird's nest tree' because its branches grow as a tangled mess. Long ago, people brought this beneficial plant to tropical Africa, Asia, and Australia. Recently, it was introduced to the Americas. The fruit of the assyrian plum is valued for its medicinal uses as a cough suppressant, pain reliever, and skin disease treatment. The shrub prevents soil erosion in the semi-arid regions where it thrives. There are over 250 similar species of shrubs throughout the world, many with medicinal uses as well.



Blackbuck

Antelope cervicapra

Once found throughout the plains of India, the blackbuck was intensely hunted until it was placed under wildlife protection acts. Males have a pair of long, spiraling horns and a coat with distinctive patterns of contrasting colors, which made it an attractive trophy animal. In the past, Indian princes hunted the blackbuck with trained Asiatic cheetahs (now critically endangered). Ironically, blackbucks that have been introduced to the Americas and Australia have thrived so successfully that some have been reintroduced to India.



Desert Date

Balanites aegyptiaca (L.) Delile

The desert date is very important to life in the desert, with uses tracing back 4,000 years to the ancient Egyptians. Its leaves and flowers can be eaten raw or cooked in a variety of ways, and provide food even in times of famine. The desert date's seeds are especially important because it contains 30-40% oil that has cooking and medicinal purposes, such as headache relief. Often growing as a lone tree in the open grasslands of Africa, the distinctive desert date also provides shelter and shade for birds and other animals.



Drumstick Tree

Cassia fistula

The drumstick tree is the national tree of Thailand and is grown throughout tropical regions as an ornamental tree. Its clusters of yellow flowers bloom so profusely that the green leaves become invisible. This tree is a legume, which is a family of plants that produce fruit and seeds that are usually edible, like beans. However, the fruit of the drumstick tree is not usually eaten, but its leaves, bark, and roots are used for traditional herbal purposes. The wood is desirable as well, since it is strong and durable.



Indian Coral Snake

Calliophis melanurus

Even though the coral snake is named after colorful animals of the sea, this slithery reptile is found on the plains and mountains of India. There are other coral snakes around the world – over 90 species, in fact. They are small and elusive snakes that eat small lizards, birds, frogs, and even other snakes, but you would not want to mess with them because they are venomous. There are some non-venomous snake species that borrow the coral snake's dangerous reputation by evolving similar colors and patterns. This defensive strategy is called mimicry, and it's quite common among animals and plants.



Margosa Tree

Azadirachta indica Adr. Juss

The Margosa tree is a relative of the mahogany tree, but with nicknames like "Divine Tree" and "Nature's Drugstore," it is obviously prized for its many medicinal uses rather than a source of wood. In addition to treating about 40 conditions, the tree produces compounds that are used to make environmentally friendly pesticides that are safe for pets and people. Even though it provides so many good uses, this fast-growing, drought-resistant tree is considered an invasive species. In Hawaii, for example, it competes with naturally existing plants for space and nutrients.



Silver Date Palm

Phoenix sylvestris

Palm trees are not true trees, but make up their own family of flowering tropical plants. Originally from India, the silver date palm can reach 40 feet tall with an umbrella of leaves that spans 25 feet. Many species of palm have contributed to human cultures for centuries, and the silver date is no exception. Its fruit is made into jelly or fermented into toddy, a wine. Palms are important to the ecosystem because their roots aerate waterlogged soils and their flowers and fruits nourish pollinators and other animals.



Teak

Tectona grandis

Teak is a very important tree that is highly valued for its quality timber. The wood has nice texture, but best of all, its natural oils make it weather and pest resistant. This makes it ideal for construction of outdoor furniture and structures. Because teak is desirable and imported worldwide, two of the three species are endangered in Burma and the Philippines. However, its economic importance has led to sustainable farming and harvest. There are now ongoing experiments to achieve high-quality wood from young trees so that old-growth forests can be relieved from logging.



Tiger

Panther tigris

As apex predators, tigers maintain populations of prey animals by keeping the numbers in control and weeding out the sick and injured. They are the largest of the big cats, and some of the most endangered, too. Even though they are extremely popular and revered as a symbol of power and reverence among many cultures, tigers have been hunted for their fur and body parts that are used in the traditional medicine trade despite no proven results.



Wild Boar

Sus scrofa

Originally from Europe and Asia, wild boars are now found throughout worldwide. They contributed to the civilization of many human cultures as the ancestors of domesticated pigs. In the wild, boars help plants grow by turning the soil as they forage. They are omnivores that prefer plants, but will happily gobble up any animals they can catch. Boars serve as food for large predators like tigers and other large cats, bears, and crocodiles. Sometimes they negatively affect an ecosystem, particularly where pigs are not naturally found. As invasive species, their voracious appetites have endangered many native animals and plants.

Middle Latitude Deciduous Forest (New England)

The main characteristic of a deciduous forest is that it has four seasons: spring, summer, fall, and winter. During each yearly cycle, changes in climate cause the trees to change the color of their leaves and lose them during the winter. Middle-latitude deciduous forests, also called temperate forests, grow near the equator, mainly in eastern North America, western Europe, and eastern Asia. This biome is one of the most heavily used by people because many of its tree species provide an excellent resource for paper and building materials. Also, the mild climate makes the biome ideal for people to inhabit.



Species:



American Beech

Fagus grandifolia

The American beech can be recognized by its smooth, silvery bark. It produces nuts that are an important food source for animals, including bears, porcupines, deer, foxes, and turkeys. Beech nuts were one of the major foods for the now-extinct passenger pigeon, and major clearing of beech forests contributed to the bird's extinction. The wood is commercially important because very hard and strong, and is used for flooring and furniture. Beech trees are susceptible to beech bark disease, which is initiated by beetles that chew on the bark, followed by fungal infection of the wound.



Balsam Fir

Abies balsamea

The Balsam fir is a small to medium-sized evergreen tree that is most recognizable as the Christmas tree. It is native to eastern Canada and northeastern United States. In September, winged seeds fall from the ripened cones and become food for many small animals such as squirrels and birds, while the leaves are an important food source for caterpillars of butterflies and moths. The trees provide cover for snowshoe hare, deer, moose, and small animals. In Canada, the resin from the balsam fir is used to make a traditional cold remedy and glue.



Black Bear

Ursus americanus

The black bear is the most common bear species native to North America. It is an adaptive animal that can live in many types of habitats, such as ridgetops, riparian areas (near streams), and tidelands, but it prefers woodlands where they can forage for food. Even though it is an apex predator, black bears are omnivores that may consume up to 90% plant matter, depending on the season. Black bears are usually solitary except for mothers with cubs. Young bears are dependent on their mothers for one and a half years, during which they learn essential skills for survival.



Bunch Berry

Cornus Canadensis

The Canadian bunch berry is a small herbaceous plant in the dogwood family. The dark-green leaves grow in a flattened formation, a whorl of six leaves. When in bloom, the tiny flowers grow as one inflorescence surrounded by a four white leaves. Most interestingly, each flower has a highly elastic filament that snaps upward to launch pollen into the air. In fact, the motion takes less than half a millisecond; each grain of pollen experiences more force than a space shuttle taking off. The fruits are edible and provide food for birds, deer, and moose.



Cottontail

Sylvilagus floridanus

The eastern cottontail is a species of rabbit found in meadows and woodlands throughout eastern North America and the very northern region of South America. Its primary ecological role is prey animal; it is an important food source for predators such as hawks, eagles, owls, foxes, coyotes, lynxes, and weasel. In fact, fewer than 25% of all young rabbits reach adulthood, after which the adult's chance for surviving a year is about 15%. Because of such high mortality rates, cottontails begin mating at three months old and can have up to seven litters a year, up to twelve kits each.



Coyote

Canis latrans

The coyote is a medium-sized canid found throughout North America. It resembles a wolf in appearance but is smaller and lighter in build and differs in behavior. Unlike the wolf, which is social and lives in a pack, the coyote is solitary or lives in a pair. It is a highly adaptable and opportunistic animal, which enabled it to expand its range as humans continue to reshape the landscape. In fact, the urban coyote population has increased over the years. Coyotes do cause some problems by preying on livestock and pets, and have been known to interbreed with domestic dogs.



Fruit Flies

Drosophila melanogaster

Fruit flies are named for their dependence on fresh and decaying vegetation during the larval stage of their lives. There are over 3,000 scientifically described species of fruit flies found throughout the world, with most existing in tropical climates. They are some of the most studied organisms used commonly in biological and genetic laboratories because of their short lifespan, high reproductive rate, and genetic diversity. Some fruit flies are unique to one very specific location so that fruit fly species have served as clues to solve criminal cases.



Golden-crowned Kinglet

Regulus satrapa

The golden-crowned kinglet is a tiny songbird that measures four inches long from beak to tail. It is round in shape and olive gray with a pale belly. White and black bands adorn each eye, with a single yellow streak on top that is more orange on males. This kinglet's high-pitched calls can be heard as it flitters through trees and shrubs to forage for insects, insect eggs, and spiders. It often flocks with other energetic insectivorous birds like creepers, nuthatches, and chickadees.



Ladies Tobacco

Antennaria plantaginifolia

The ladies tobacco is a small, perennial evergreen wildflower that is common in open, dry woods of the Eastern United States. It grows in small mats about two to three inches high. It has dark-green to silver leaves, with distinctive ten-inch tall flowers that are clustered, fuzzy, and shaped like a cat's paw - hence its other common name, pussytoes. This tolerant perennial is cultivated as groundcover in gardens because its matting habit provides excellent erosion control.



Sugar Maple

Acer barbatum

The sugar maple is an important component of many forest types in eastern North America. This tree plays a special ecological role because its roots provide hydraulic lift throughout the soil; the roots pull water from deeper layers and release it into shallower substrate, which benefits other plants as well. Sugar maple is also important to people, as its name implies, it is cultivated for its sap - the source of maple syrup. Its wood is one of the hardest and densest, making it practical for sports equipment like baseball bats and bowling alley flooring.



Sugar Pear

Amelanchier canadensis

The sugar pear is a small, deciduous shrub or tree that grows in the understory of temperate forests. It is native to the Atlantic coastal plain of North America, where it grows in wet habitats. Sugar plum has distinctive white, five-petaled flowers that develop into small, edible fruit that have a dark, purple color when ripened. Like many berry plants, the sugar plum seeds have a greater chance of germinating if they pass through an animal's stomach after the fruit is eaten.



White-Tailed Deer

Odocoileus virginianus

The white-tailed deer is the most common deer in the Americas. As a generalist, it takes advantage of many habitat types. A deer has a four-chambered stomach that allows it to eat many kinds of vegetation and digest it at a later time. The tough stomach even allows a white-tailed deer to add poisonous mushrooms and red sumac to its diet of legumes, shoots, leaves, cactus, grass, and fruits. During the autumn rutting (mating) season, males will spar for the right to mate with females in his territory. Each spring, one to three spotted fawns are born to each female.

Taiga (Scandinavia)

The most common biome in the world is the taiga, also known as boreal forest. This habitat is found far north, but south of the Arctic Circle. With little diversity, a majority of the plants that make up a taiga are coniferous trees, which are trees that grow their seeds in cones and have evergreen, needle-shaped leaves. Summers have long hours of daylight, while it is very cold and snowy during winter months. Animals that live on taiga have special ways of coping with the harsh environment, like morphing into a white winter coat and migrating long distances.



Species:



Alpine Bistort

Polygonum viviparum

The Alpine bistort is a flowering plant commonly found in high, mountainous regions of the Arctic. Like most alpine plants, it grows very slowly; individual leaves and flowers may take three to four years to reach full size and maturity. The full alpine bistort only grows to about a half foot tall, but it has a thick rootstock and produces small bulbs that are rich in starch. It serves as a good source of nutrients for arctic animals like ptarmigans and reindeer.



Arctic Fox

Alopex lagopus

The Arctic fox is a small canine adapted to life in frigid climates. It has a rounded body that maximizes heat retention, along with a layer of fat and thick fur for insulation. It will eat anything it can find, from lemmings, eggs, hares, baby ringed seals, to leftovers from a polar bear's meal. Although the worldwide population is generally good, there are places where the arctic fox is endangered due to hunting and diseases transferred by

domestic dogs. It is also out-competed by the red fox, which becomes the new top predator in areas where wolves have been depleted.



Arctic Wolf

Canis lupus arctos

The arctic wolf is a subspecies of the grey wolf that is geographically restricted to the arctic regions of North America and Greenland. Subjected to sub-zero temperatures with long periods of darkness, and sometimes weeks without food, arctic wolves depend on their social family groups to survive. All adults in a pack will cooperate in a hunt to bring down large prey, mainly caribou or musk oxen. Pack members also do their part to care for the young and old. The arctic wolf is one species affected by global climate warming, which disturbs food chain dynamics on all levels.



Caribou

Rangifer tarandus

Caribou, or reindeer, is a Holarctic species that is widespread around the northernmost regions of the globe. Wild populations of caribou have fluctuated historically, but today, many herds are in decline due to habitat loss and climate change. The warming temperatures are especially significant because it alters the abundance and types of plants at faster rates than herds can adapt their foraging behaviors. In addition, the caribou's ability to survive in extreme cold offers protection from animals that hunt them, but warmer climates allow more predators to encroach further north.



Gyrfalcon

Falco rusticolus

Gyrfalcon, the largest of the falcons, can be found in the arctic regions of North America, Europe, and Asia. Females are bigger and bulkier than males, measuring over two feet long and weighing over 4.6 pounds. The species is highly polymorphic, which means that there is high variance in coloration; gyrfalcons exist in all color gradients and patterns from white to silver, brown, and black. They are strictly carnivorous birds that prefer live prey of rodents, hares, and coastal birds. Their only natural predator is another raptor, the golden eagle.



Lady Fern

Athyrium filix-femina

The lady fern is a deciduous, perennial plant native to the United States that grows two to five feet in height and prefers cool, moist soil in the shade. A hardy and graceful plant, it is cultivated in gardens and as ground cover. The lady fern is a member of a very ancient family of plants that have been around since 360 million years ago, each species of which has very specific environmental conditions. Thus, ferns are good indicators of the health of an ecosystem.



Norway Spruce

Abies pinagene

The Norway spruce is a large, evergreen coniferous tree that grows up to 180 feet tall. Its needles are short and dense, and the cones are large and round. Originally from Europe, Norway spruce has become one of the most widely planted trees throughout the world because of its ornamental quality. In some areas outside of its range, this adaptive tree has become naturalized, forming its own patches in

forests. Its fast growth rate makes it an ideal species for the Christmas tree industry, as well as a good source for timber and paper materials.



Reindeer Moss

Cladonia rangiferina

This lichen is called the reindeer moss because it is a major food source for caribou. Since caribou is important to people of the far north, lichen is valued by people as well. Some ethnic groups also use reindeer moss as a traditional remedy for ailments. It is extremely hardy in the cold, alpine taiga climate where it grows in dense, highly branched mats up to one foot tall. However, it is slow growing, taking five years to replenish. In some places, reindeer moss is classified as a threatened species and harvest is limited.



Scots Pine

Pinus sylvestris

The evergreen, coniferous Scots pine is native to Europe and Asia, with over 100 described varieties. It is a slow-growing tree that can reach 150 feet tall and typically lives for up to 300 years, although there are specimens over 700 years old. It is important to forestry, as its wood is used for pulp, timber, and historically, tar production. Scots pine is commercially farmed with rotations of 50 to 120 years. Even so, its natural distribution has greatly diminished due to forest fires, overgrazing by sheep and deer, and deliberate deforestation to reduce the range of wolves.



Snowshoe Hare

Lepus americanus

The snowshoe hare is adapted for survival in cold, snowy climate. Its feet is broadened for greater surface area and padded with thick fur to enable the hare to move quickly on top of snow. Each winter season, the snowshoe hare molts, or sheds, its brown fur and replaces it with a white coat in order to camouflage into the winter landscape. Even so, keen predators like eagles, wolves, mountain lions, and even people rely on snowshoe hare for food.



Willow Ptarmigan

Lagopus lagopus

The willow ptarmigan is a type of game bird called a grouse, and is the largest of the three ptarmigan species. It can be distinguished from the red combs over its eyes. This ptarmigan is unusual because the males care for the chicks from the time they hatch until they are independent. They are so protective that ptarmigan fathers have been observed attacking grizzly bears. Like the snowshoe hare, this arctic bird grows thicker covering over its feet during the winter for better protection from snow. Its preferred habitat is thickets with alder and willow trees.



Woolly Willow

Salix lanata

The woolly willow is a member of a large, highly varied family of trees, although it is a shrub that has adapted to cold climates in mountainous regions of Europe and Asia. It is named for its silvery-green, oval leaves that are covered in hairy fibers. This shrub is dioecious, which means that there are distinct male and female plants. Unlike other coexisting trees, it requires pollination by insects and thus provides nectar for bees. The woolly willow is listed as a priority species for conservation in Scotland, where there are protective measures to prevent grazing from sheep and deer.

Temperate Coniferous Forest (California/Oregon)

Temperate coniferous forests are dominated by evergreen trees and usually have lots of rain and mild winters. They are common to coastal regions, and may extend inland. Generally, there are two layers: the overstory composed by taller trees, and the understory that is full of herbaceous plants, shrubs, ferns, mosses and more. Temperate coniferous trees are some of the largest organisms on the planet, with members such as the Giant Sequoia. A unique habit of many temperate forests is that they undergo yearly forest fires to renew nutrients in the soil and promote seed growth.



Species:



Black Bear

Ursus americanus

The black bear is the most common bear species native to North America. It is an adaptive animal that can live in many types of habitats, such as ridgetops, riparian areas (near streams), and tidelands, but it prefers woodlands where they can forage for food. Even though it is an apex predator, black bears are omnivores that may consume up to 90% plant matter, depending on the season. Black bears are usually solitary except for mothers with cubs. Young bears are dependent on their mothers for one and a half years, during which they learn essential skills for survival.



Blue Bunchgrass

Festuca idahoensis

Blue bunchgrass is highly abundant, making up much of the prairie grasslands in western North America. This hardy perennial grass is drought resistant and supports biodiversity. For example, its leaves provide food for the larvae of many insect species, and its

flowers provide nectar for many butterflies and moths. Bunchgrass ecosystems have been much degraded for the past 150 years due to agriculture, grazing, fires, and invasive species. Fortunately, there are efforts to restore the habitats.



Foxtail Pine

Pinus balfouriana

Foxtail pine is a rare species of coniferous tree that coexists with the weeping spruce and giant sequoia in the Klamath and Sierra Nevada mountain ranges. Like many native Californian trees that endure seasonal wildlife regimes, it has built-in fire resistant features: a very thick layer of bark for protection from fire damage and sparse branches to discourage spreading of flames. Since it inhabits high altitudes, the foxtail depends on pollination by wind. It is not harvested commercially, so it is not important economically.



Giant Redwood

Sequoiadendron giganteum

Giant redwoods, or sequoia, are the world's largest trees and are exclusive to the western Sierra Nevada Mountains of California. They typically reach 280 feet tall with a diameter of 24 feet at the trunk. This coniferous species produces from 300,000 to 400,000 seeds per year, but few seedlings survive due to strict requirements of mineral soils and full sunlight. Survival of the species depends on wildfires to eliminate competing vegetation, return nutrients to soil humus, and cause mature cones to release seeds. Redwood groves are protected from harvest, and young trees are cultivated for timber and as ornamentals.



Lynx

Felis lynx

The lynx is a medium-sized cat with characteristic black-tufted ears, a ruff around its neck, and a bobbed tail. The legs are long with broad paws for walking through snow. A predator with extremely keen senses, lynx can detect snowshoe hare - its dominant prey - from a distance. There are efforts to reestablish the endangered lynx in some of its former territories after it was hunted to near extinction for the fur trade. A relative, the Iberian lynx of Europe, is critically endangered. Global warming poses a threat for lynx by altering habitats and availability of prey.



Moose

Alces alce

The moose is the largest species in the deer family, highly recognizable by the male's huge, flaring antlers. It lives in forests of Canada and northern Asia and Europe south of the arctic zone. Cave paintings depict the importance of moose as a source of protein for people since early civilization, and today this deer remains a favorite for big-game hunters.

Their natural enemies are bears and wolves. Moose are hedge browsers that forage the terminal tips of plants, similar to the way that a gardener prunes, which helps promote plant growth.



Northern Goshawk

Accipiter gentilis

The Northern goshawk is a widespread North American raptor known for its supreme ability as a hunter. An agile flier, it is equipped with short, broad wings and a long tail that enable it to navigate through dense forests. Its prey includes squirrel, grouse, and snowshoe hare. It is a persistent hunter and will focus on a specific animal for over an hour if necessary. Goshawks also exist in the United Kingdom and Ireland, having made a comeback since they became extinct in those areas during the 19th century. They were over-collected for use in falconry.



Port Orford Cedar

Chamaecyparis lawsoniana

The Port Orford cedar is actually a cypress tree species native to Oregon. The foliage is feathery and the leaves are scale-like. It is important in horticulture, grown selectively for its shape and blue-green color as an ornamental. The light yet durable wood is highly valued in Asia, especially in Japan, where the wood is used to make coffins and shingles for shrines and temples. This cypress is considered a threatened species because it is highly susceptible to root disease caused by a fungus that spreads by water.



Pronghorn

Antilocapra Americana

The pronghorn is often called an antelope, although it is actually the sole surviving species of the family Antilocapridae. It has distinctive antlers that are protrusions of bone from the skull, covered by an outer sheath that is shed annually. Its home is the open grassland plains of North America, where it has evolved the ability to run at exceptional speed; it is second only to the cheetah as the fastest land animal. Pronghorns often form herds of up to 1,000 individuals and can be seen with the American bison.



Snowshoe Hare

Lepus americanus

The snowshoe hare is adapted for survival in cold, snowy climate. Its feet is broadened for greater surface area and padded with thick fur to enable the hare to move quickly on top of snow. Each winter season, the snowshoe hare molts, or sheds, its brown fur and replaces it with a white coat in order to camouflage into the winter landscape. Even so, keen predators like eagles, wolves, mountain lions, and even people rely on snowshoe hare for food.



Tiger Lily

Lilium paradalinum

The tiger lily is a perennial flower native to North America. It grows to nearly 3 feet tall and produces attractive red or orange blossoms between June and August. It is pollinated by hummingbirds and requires open, moist meadows for growth. It is federally listed as endangered after much of the wild populations were depleted by wetland filling, collection by horticulturalists, and development. Remaining wild tiger lilies exist on private land and had to be protected by means of conservation agreements between land owners and conservation groups.



Weeping Spruce

Picea breweriana

A rare species of evergreen coniferous tree, the weeping spruce is naturally found only on the high-altitude Klamath Mountains of Oregon and northwest California. It grows less than a foot per year due to snowy winters. Even so, it is a large tree that reaches up to 170 feet tall and five feet wide at the trunk. The drooping branches for which this tree got its name are an adaptation that reduces breakage of branches by heavy snowfall. The weeping spruce is prized as an ornamental tree for its dramatic pendulous branches.

Temperate Grassland (Australia)

Temperate grasslands are flat plains that are composed of a wide variety of perennial grasses. Examples of this biome include the prairies of North America, steppes of Eurasia, pampas of South America, and savanna in Australia. On most continents, these grasslands are home to large herbivores that live in large herds. Even though the soils are very fertile, the dense grasses and constant grazing is enough to prevent tree growth. In Australia, however, the lack of large mammals allows trees to grow. There are many marsupials and reptiles that inhabit the Australian temperate grassland, as well as trees like eucalyptus.



Species:

Australian Coral Snake

Simoselaps australis



The colorful Australian coral snake can be identified by its banded pattern of black and white on red. Sometimes the bands are very subtle that it appears as a fishnet pattern with a few thick black bands around the head. It only grows about 1.5 feet long and is virtually harmless, although it is weakly venomous.

The Australian coral snake is not commonly seen, most likely due to its nocturnal and burrowing habits. It feeds on skinks and other small reptiles including other snakes, as well as eggs.



Barley Mitchell Grass

Astraleba pectinata

Found in the arid regions of inland Australia where rainfall is scarce, the barley mitchell grass has shallow surface roots as well as deep vertical roots to take full advantage of even the lightest rain showers. It is an edible plant that resembles wheat or barley in appearance, growing just over 30 inches tall and having a head with seeds

packed in rows. It serves as a year-round, natural food source for grazing animals. It is also harvested for cereal production.



Brush-tailed Rock Wallaby

Petrogale penicillata

The brush-tailed rock wallaby is a marsupial that resembles a miniature kangaroo. As its name suggests, it prefers to dwell in places with a lot of rocks and caves. It is an agile jumper and can climb trees very well, too. Rock wallabies live together in a colony, and together they will forage for grasses, roots, and bark during the night until the early morning hours. In general, the brush-tailed wallaby is common, but it is nearly extinct in some areas due to habitat loss.



Bull Mitchell Grass

Astrebla squarrosa

There are four species of Mitchell grass, named in honor of Sir Thomas Mitchell, who discovered the nutritious plants back in 1835. The bull Mitchell variety is the least palatable. This drought-resistant grass will grow widely in the dry tropics of northern Australia, where the hard, caly soils is unfavorable for trees. Interestingly, Mitchell grasses has evolved with grazing animals so that these long-lived plants (typically 20-30 years), require moderate grazings to promote growth.



Eastern Blue-tongued Skink

Tiliqua scincoides intermedia

The stubby, smooth-scaled Eastern blue-tongued skink is the most common of six skink subspecies from the Australian outback. When irritated, the skink's defense is to open its mouth wide and stick out its unusually blue tongue to startle whomever it encounters. Another unusual fact about the skink is that the babies are born alive. As soon as they are born, they can find food themselves and will be independent in a few days. Like many Australian animals, skinks often fall prey to cats and dogs. The Eastern subspecies is not of concern, but others are threatened or endangered.



Hill Wallaroo

Tiliqua scincoides intermedia

The Australian hill wallaroo is the largest of the macropods, a family of marsupials that includes kangaroos and wallabies. It is best adapted to the hot, arid, nearly-desert grasslands that average less than 15 inches of rainfall each year. This marsupial has evolved to require very little water and eat low-nutrition foods like spinifex and grasses. Scientists are quite interested in the hill wallaroo's physiological adaptations, such as its highly efficient excretory system that enable it to recycle nitrogen and retain water.



Koala

Phascolarctos cinereus

The koala is an Australian marsupial that resembles a plush bear. It is unique in appearance, with beady eyes, a large oval nose, fluffy ears, a soft grey coat and white belly. The koala is a slow animal and is either motionless or asleep for 16-18 hours a day. It is arboreal, spending most of its time in trees and most of its active time munching on eucalyptus leaves. Although popular as a cultural animal, the koala was nearly hunted to extinction for its fur, and now is a high priority species protected by the Australian government.



Manna Gum

Eucalyptus viminalis

A species of eucalyptus, the manna gum is a tall, slender tree growing to 130 feet or taller. The bark is rough and peels away in ribbons, while the timber is a pinkish-brown color with light grey streaks, which make it desirable for furniture. The silvery-green leaves are long and tapered, best known as an important food for the koala. Its sap is 5-15% sugar, which offers high-energy nutrition for birds and sugar gliders. Even though it is native to a temperate climate, the manna gum is hardy in cool weather and is grown as an ornamental in Europe.



Red River Gum

Eucalyptus camaldulensis

The Red River gum is one of eight hundred species in the eucalyptus genus. It is commonly found in the waterways of Australia, where most other species of eucalyptus can be found. It provides shelter and nesting places for many aquatic birds. Red River gum trees can be very old, and there are individuals that are over 700 years old. After growing for 120-180 years, a hollow would form in the trunk, which creates homes for more wildlife like bats and snakes.



Salt Bush

Atriplex semibaccata

The salt bush belongs to a family of plants with about two hundred species that are mainly found in desert and seashore environments. It is so named because of its distinct ability to tolerate extremely salty conditions. The leaves retain a high concentration of salt that gives this edible plant a salty, spinach-like taste. In Europe and the Mediterranean regions, it was used in salads and pasta before spinach became the norm. Salt brush is more commonly used to feed sheep because it improves the taste and nutrition of the meat.



Silver-leaved Ironbark

Eucalyptus melanophloia

The silver-leaved ironbark is a tall, attractive tree often grown as an ornamental. When in bloom, its white flowers contrast with the silvery-blue leaves. It grows easily and is tolerant of most soil types, frost, and drought. These trees, along with other similar species, are collectively called ironbarks because they do not shed the bark annually like other eucalyptus trees; instead, the dead bark accumulates and forms rough fissures. After drying and collecting sap produced by the tree, the bark forms a thick, fire-resistant layer that protects the inner living tissue within the branches and trunk.



Spotted-tailed Quoll

Dasyurus maculates

The spotted-tailed quoll is the second largest carnivorous marsupial in the world - and it is only the size of a domestic cat. It resembles an opossum in body shape and is dark-brown in color with white spots from the face to the tail. If looks can deceive, this small critter is actually a hunter of many small animals, and its modus operandi is biting the prey behind the head. But like many marsupials, it is no match for introduced animals like European foxes, cats, and dogs that compete for food and spread disease. The spotted-tailed quoll is endangered.

Tropical Dry Forest (Peru)

Tropical dry forest biomes are found in warm climates of India, Australia, Central and South America, Mexico, Africa, and Madagascar. Compared to rainforests, dry forests receive less rain, at least 20 inches a year, and so the trees tend to be smaller. There are typically fewer species in dry forests, too, although there is still a high level of biodiversity. Tropical forests are known for producing beautiful woods that have high commercial value, which motivates deforestation, unfortunately. But there are greater reasons to save these forests because they produce medicinal sources, maintain climate conditions, absorb carbon dioxide, and more.



Species:



Bayonet Bromeliad

Bromelia secura

The bayonet bromeliad is known as chaguar in South America, where it is found in the semi-shade, middle layer of Chaco forests. Bromeliads are a group of plants with over 3,000 species that vary greatly in appearance, but typical bromeliads have leaves that grow in a tight, spiral formation, called a rosette. This creates a cup-like shape that can hold water. The bayonet bromeliad is spiny with tough fibers that are sustainably collected by the Wichi tribe and woven into clothing, bags, nets, and ropes. Crafts made with wood and chaguar provide a source of income for Wichi groups.



Blue Needle Palm

Trithrinax campestris

The short, squat blue needle palm is a formidable plant with spines on its trunk and incredibly stiff, sword-like leaves. It is native to Argentina and is tolerant of

extremely hot weather, frost, strong winds, and drought. It produces a fruit that is juicy, sweet, and succulent, followed by a sour taste like that of green persimmon. Rather than eaten fresh, the fruit is fermented into an alcoholic beverage. The leaves are rich in tough, strong fibers that are used in manufacturing crafts, hats, shoes, and fans.



Boa Constrictor

Boa Constrictor

The boa constrictor is a large, heavy South American snake that kills prey by coiling its body around and constricting the animal until it dies, then swallowing it headfirst. It is ovoviviparous, meaning that the baby snakes are born live instead of encased in eggs. Boas are easily tamed and popular as pets. Unfortunately, they are often released when owners can no longer manage their large size - up to 14 feet and 60 pounds. Boas and other pet snakes that are released into the wild have become invasive species proven detrimental to much native wildlife.



Cursor Grass Mouse

Akodon cursor

One of the most common species in the Atlantic forests and grasslands along the coast of Brazil, the cursor grass mouse serves as food for many raptors, snakes, and carnivorous mammals. It is a medium-sized, vole-like mouse with short legs and tail, and relies on ground cover and brush to hide from predators. It feeds on plant material, seeds, and larvae and adult insects, which is important for seed dispersal and pest control. Even though the Brazilian forests are being cut down at alarming rates, the populations of cursor grass mice does not yet seem to be affected negatively.



Geoffroy's Cat

Leopardus geoffroyi

The versatile Geoffroy's cat can be found in many kinds of environments throughout all of South America, from scrub desert to open bush, woodlands, and mountains. Its adaptability and tolerance has enabled it to maintain a stable population despite pressures from human activities like deforestation. It is also the most hunted wild cat because of its golden-tan and black-spotted coat, with nearly 150,000 pelts traded in a year. On the other hand, this small feline is easily tamed, and many Geoffroy's cats are kept as pets to control rodents.



Mountain Sandwort

Arenaria montana

During the spring, clusters of white, round flowers from the mountain sandwort adorn the Pyrenees Mountains of France and Portugal. They are also found on mountainsides of North America. The small, herbaceous evergreen perennial prefers slightly acidic, sandy, and well-drained soil. It has a creeping habit, which means that the plants grow laterally by extending its shallow roots sideways. Such creeping plants provide good ground cover because they reduce erosion. Mountain sandworts are a favorable addition to rock gardens because of their showy flowers.



Pampas Deer

Ozotoceros bezoarticus

Pampas deer live on low-level grasslands of South America, mainly in Brazil. Its natural predators are jaguar and puma. In the past, pampas deer were as important to native South Americans as the bison was to Native Americans.

Today, there are only about 80,000 Pampas deer. They are classified as threatened because of habitat loss, with over 99% of its natural range lost since 1900. They were also severely hunted in the 1800s; in a ten-year period, over two million pampas deer pelts were exported to Europe. They are now legally protected.



Screaming Armadillo

Chaetophractus vellerosus

Armadillos are known for their ability to transform into an armored ball for defense, but the screaming hairy armadillo also makes loud squeals to startle potential predators. To avoid predators in the first place, it spends a lot of time in burrows, which it digs with its strong claws. The hairy armadillo is a solitary omnivore mostly active at night to escape the heat. It will eat insects, snakes, smaller mammals, and plants. The only time it mingles with other hairy armadillos is during mating season, after which one to four offspring will be born after 60-75 days of gestation.



Molina's Hog-nosed Skunk

Conepatus chinga

The skunk is a member of the weasel family that is notorious for its stinky defensive behavior. Glands under the base of the tail produce a foul-smelling liquid that can be sprayed up to 15 feet away. The high-contrast colors of black with white stripes serves as a warning pattern for brave predators that eat skunk, including birds of prey, foxes, and snakes. Another anti-predation adaptation is resistance to pitviper venom. The skunk is typically slow moving, although it covers a large range up to 40 acres per individual, but rarely more than two miles from a water source.



Star Cactus

Astrophytum asterias

The star cactus is also called sand dollar cactus and sea urchin cactus because of its resemblance to the marine animals. A small plant, it usually spans two to six inches in diameter and one to two inches tall. It produces a single flower that lasts most of the summer. The star cactus is listed as vulnerable because of urban development and collection by enthusiasts. Fortunately for this slow-growing, spineless cactus, it reproduces by seed and there are plant nurseries that ensure a supply of this popular succulent.



Wax Palm

Ceroxylon quindiuense

The wax palm appears as a single, branchless trunk over 150 feet tall, topped by a crown of feathery fronds. The entire length of the trunk – the tallest of all palms - is covered by a waxy coating that was used to make candles during the times before electricity. In fact, the slow-growing palm is considered vulnerable and faced near extinction from unsustainable use. Today, it is protected by the Colombian government and recognized by the country as the national tree.



White Carob Tree

Prosopis alba

The white carob tree is a medium-sized tree of South America. It has brown-gray bark and small, greenish-white flowers that are pollinated by wind and insects. Its fruit matures as pods that contain brown seeds that are sweet, pasty in texture, and high in calories. People use the seeds as fodder (animal feed) and for consumption by making it into flour or fermenting it into alcohol. The white carob is drought resistant and is planted along roadsides as an ornamental that also reduces wind.

Tropical Grassland (Sudan Grass Belt)

Tropical grasslands grow north and south of rainforests and are usually subject to floods seasonally or year-round. Also known as savanna, this ecosystem supports many species of grasses and shrubs. Some trees grow in tropical grassland, but they are sparse enough to maintain an open canopy that allows sunlight to reach the herbaceous plants layer on the ground. Regular wildfires help prevent large trees from establishing in this biome. There is some evidence that global climate change is altering the landscape of tropical grasslands, with the result that more woody plants are growing than before.



Species:



African Grass Rat

Arvicanthis niloticus

The African grass rat is a medium-sized rodent that lives in colonial burrows of sub-Saharan Africa. It requires ground cover, which is any form of low-growing vegetation that provides shelter to hide from predators like eagles and barn owls. It is usually found in habitats such as dry savanna, sub-desert, coastal scrub, and open wood and grassland. In addition to serving as prey for many carnivores, the grass rat is an important part of African biodiversity and helps maintain other rodent populations by serving as natural competition.



Elephant Grass

Pennisetum purpureum

Like the animal it is named after, the elephant grass originates from Africa and is very tall, reaching up to ten feet tall. It naturally thrives along lakes and rivers where the soil is rich, and grows by spreading underground shoots, called rhizomes, through the roots. It is so dense and the leaves have such sharp edges that it forms

an impenetrable barrier. However, this makes an ideal shelter for many bird species. Elephant grass can be a problem when introduced to new places because it clogs the natural waterways and depletes the nutrient resources for other plants.



Giraffe

Giraffa camelopardalis

The giraffe has been a wonder for people since the time of ancient Greeks and even appeared as far as China circa 1414. Its unique body structure is well adapted to life on the African grasslands. Its long neck enables it to reach leaves of the acacia tree, and allows it to see potential predators lurking among the grass. Giraffes can run up to 35 mph and deliver deathly kicks with its powerful legs. There are actually nine subspecies of giraffes that can be distinguished by differences in the patterns and shapes of their spots, as well as geographic range.



Haskaneet

Cenchrus biflorus

In Nigeria, one of the places where haskaneet is found, it is called cram-cram. It is an annual grass common to the savannas and grasslands of Africa and India. People of India use the seeds of the haskaneet to make bread, sometimes mixing it with the grains of another plant, Bajra. For now, this traditional food plant is not widely known in Africa, but it has the potential to be bred for better nutrition and become a sustainable food source to boost rural development.



Lion

Panthera leo

The lion is the second largest big cat, but has always been regarded as the most regal of animals in human culture. The adult male's mane most likely contributed to its status symbol, as well as its social behavior. As an exception to the feline code for solitary living, lions live together in a pride. Hunting is predominantly executed by the lionesses, although the males get to eat first. The lion is a keystone and apex predator that maintains balance among populations of both prey and other predators. Unfortunately, lions face a great threat from habitat loss and hunting pressures.



Patas Monkey

Erythrocebus patas

The patas monkey is a species of ground-dwelling monkey known for being the fastest primate. It lives in the open savanna and semi-deserts across the African continent, places where the ability to run up to 35 mph is crucial for escaping a variety of predators such as leopards, cheetahs, hyenas, eagles, jackals. Its long tail, which makes up nearly half of the body length, helps provide balance. Patas monkeys can climb trees quite well, especially as it forages for leaves, fruit, seeds, insects, and young birds. They are also known as guenons.



Red Fox

Vulpes vulpes

The red fox is a small member of the canid family, but its ecological and economical importance is quite expansive. Common throughout the Northern Hemisphere, its range spans North America, Eurasia, and the very northern edge of Africa, as well as Australia, where it has been introduced. It plays the role of a solitary, omnivorous

predator in a variety of biomes from prairie to forest, scrubland, and tundra. Foxes have been a part of human culture for centuries, being associated with cleverness since Aesop's time. It is hunted for sport and has been domesticated for the fur industry.



Sausage Tree

Kigelia pinnata

The sausage tree gets its name from its sausage-shaped fruits that measure about 3.25 feet long. It is a flowering tree valued for its medicinal properties. Curiously, the fruit is poisonous when fresh, and must be dried and roasted, sometimes fermented before it is used as a traditional herb to cure ailments like rheumatism and snakebites. It is even applied for

supernatural purposes like warding off evil spirits and tornadoes. The sausage tree has large, attractive fuchsia flowers that qualify it as an ornamental, although its heavy, woody fruit presents a hazard when falling.



Sudan Grass

Sorghum

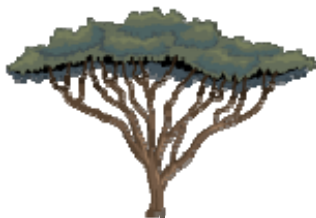
Sudan grass is a long-stemmed, long-leaved plant raised for grain. It is native to tropical and subtropical regions of eastern Africa, although it is cultivated as an important crop plant in southern Europe, Asia, and the Americas. It is hybridized with sorghum grass to produce plants that can endure cool climates. As young plants, sudan grass produces prussic acid, a form of cyanide, that is toxic to animals, although the levels are low and rarely harms grazing animals, like cattle and sheep.



Topi

Damaliscus korrigum

The topi is an ungulate (a large, hoofed herbivore) that is known for being exceptionally social. It lives in a herd of 15-20 animals, sometimes up to a hundred, that is led by a dominant male. Topi would often mingle with other species like zebra, ostrich, and other antelope. This colorful antelope has a reddish-purple coat with steel-gray and tan patches on its legs. Its muzzle is long and narrow, which is useful for selecting the tenderest young shoots. Both male and female topis grow thick, ringed, and curved horns.



Umbrella Thorn Acacia

Acacia tortilis

One of the most recognizable trees of Africa, the umbrella thorn acacia is a medium-sized tree with a broad, flat canopy. Its shape maximizes sunlight absorption and makes it an important addition to the hot, dry savanna by providing shade for many animals. However, the tree isn't entirely beneficial to animals; the acacia's thorns grow in sets of two, one long and straight, and another short and hooked.

This defense successfully protects the leaves, flowers, and seed pods from most animals except for the giraffe, whose long, dexterous tongue can reach the succulent leaves.

**Wild Date Palm***Phoenix sylvestris*

A common sight in India is the wild date palm, and in some districts, it is the only tree. It is a small palm, growing to 36 feet at most. The thick trunk is densely armored by the bases of fallen leaves, while each frond has many rigid leaflets growing at alternate angles for a spiky look. Ripe fruits are brown and are made into jelly. More economically important is the sap, which is collected and fermented into an alcoholic drink, toddy. Trees that are tapped for sap grow at curious angles and the fruits are inferior in quality.

Tropical Rainforest (Brazilian Amazon)

With over 60 inches of precipitation each year, tropical rainforests are extremely lush environments that support high productivity and countless plants and animals. Giant trees standing more than 200 feet tall are common. Rainforest are estimated to have covered about 12 percent of land just a few thousand years ago, but now totals less than 5 percent due to unsustainable harvest of timber and clearing for farms. The largest remaining tropical forests are in Brazil, Congo, Indonesia, and Malaysia. If these habitats are lost, many species such as orangutans and plants that hold medicinal powers will be lost, too.



Acai Palm

Euterpe oleracea

The global demand for acai palm products has skyrocketed in recent years, leading to the commercial cultivation of this palm species. Palm hearts are harvested by cutting the inner core above the growing stem. The fruit, which is a berry, has traditionally been a large part of Brazilian diet. It is marketed as a dietary supplement that increases energy, detoxifies the digestive system, and promotes weight loss. However, these claims await scientific support. Nonetheless, the palm is extensively grown along the Amazon estuary where it grows very close to the water, sometimes partially submerged during flood seasons.



Cacao

Theobroma cacao

One of the world's most famous flavors – chocolate – is derived from cacao (or cocoa) tree. It naturally grows in the deep tropical rainforests of

South America, where shade and constant rainfall is important for its growth. The cacao's small white flowers are specifically pollinated by flies called midges. Its fruit grows as a large pod about one-foot long, inside of which are the famous cocoa beans. There are 20-60 beans in each pod, and the high-fat content of the seed is cocoa butter. Cacao is cultivated in 63 countries for a total of over 17 million acres.



Hyacinth Macaw

Anodorhynchus hyacinthinus

With its brilliant blue plumage and bright yellow surrounding its eyes and jaw, the hyacinth macaw is one of the most sought-after birds. It contributes to tourism in Brazil, which helps the country economically and provides a reason to preserve the tropical rainforests that are home to so much biodiversity. The hyacinth has a very long lifespan of decades but very low reproduction. It mates for life and nests in holes in trees and cliffs. Like many other parrots, wild populations of the endangered hyacinth macaw have decreased significantly because of over-collection for the pet trade.



Jacaraeubas

Calophyllum brasiliense

In Latin, the jacareubas means /“beautiful leaf”/, and is also known as guanandi. It is an evergreen tree native to the tropical and subtropical regions of Central and South Americas. Growing up to 150 feet tall, it has a dense, rounded crown full of broad, elliptical leaves that measure about six inches long. Jacareubas grows in homogenous groves, which means that only one species exists in a particular area. This trait, as well as its fast growth and excellent timber quality, make it a very important species of the tropics because it saves many other Amazon trees from harvest.



Jaguar

Panthera onca

The jaguar is a big cat smaller only than lions and tigers, but its power easily rivals that of the other two. It lives in dense Amazonian jungles where its rosette-spotted tan coat offers excellent camouflage for the solitary hunter. This apex predator hunts by ambushing its prey and delivering a fatal bite to the skull of its prey. It can even pierce the tough armor of turtles and caiman, a relative of the crocodile. Even so, the jaguar faces many threats and is currently in decline due to habitat loss. It is still being hunted for its fur.



Milk Tree

Couma utilis

The milk tree is commercially important because it produces latex, which is a white, saplike fluid that is used in making chewing gum, glue, varnish, caulk, and other industrial products. Locals use the sap as a substitute for cream in their coffee and the seeds are ground into a meal. It is native to dry, non-flooding fields and grasslands of the Amazon. The tree can be as tall as 50 feet with dark green, oval leaves. The small, round fruit of the milk tree is called couma, and resembles the guava in having several seeds embedded in a pulpy flesh.



Polygonanthus

Polygonanthus amazonicus

Polygonanthus is endemic to the extremely moist lowland Amazon basin, where rainfall amounts up to 160 inches a year. This region supports much biodiversity because the soils are made up by many different substrates, which supports a variety of trees that create unique niches. Polygonanthus is one of these species, and a very rare one. It is an angiosperm, which means flowering plant. Its flowers have pointed petals surrounding multiple stamens (male parts where pollen is produced). The leaves are oval-shaped leaves with symmetrical veins.



Rubber Tree

Hevea brasiliensis

The Para rubber tree is the most economically important species of rubber trees. In the wild, it can grow up to 144 feet tall, but in plantations it is cultivated to 78 feet. The latex is a sap-like fluid used to make rubber, and it is produced in vessels that spiral up the tree in the living bark layer. Incisions are made just shallow enough to tap the latex, but not deep enough to harm the tree's growth. Most plantations are not in South America where the tree is native, but in South and Southeast Asia.



Tapir

Tapirus terrestris

The unusual tapir looks prehistoric, and in a way it is. Scientists believe that it has not changed much over tens of millions of years. Tapir is related to rhinoceros, but has a body like a pig's, reaching up to 42 inches at the shoulder and weighing 800 pounds. It has a short, prehensile trunk that is an extended nose and upper lip, used to grip leaves and fruit. Baby tapirs are brown with white stripes for camouflage that morphs into the adult gray color. There are three species of tapir in South America and one in Asia, all endangered.



Tegu Lizard

Tupinambis

There are at least seven species of tegu lizards from South America. The body is slender, the head is narrow and pointed, and the tail is about half of the entire two-to-four foot length. With its banded pattern of black-brown against off-white, it resembles an alligator although it is not related. Two species of tegus are very docile and is very common in the pet trade, where it is sometimes referred to as alligator lizard. In the United States, it is illegal to release this predatory lizard into the wild because it poses a threat to small native animals.



Toco Toucan

Ramphastos toco

The Toco toucan is an iconic South American bird, with its large, curved, yellow bill and white throat contrasted with black plumage. It inhabits semi-open woodland and savanna of Bolivia and Panama. The toucan's famous bill is the largest relative to body size of any bird and serves a variety of purposes. Mainly, it is used to pluck figs – its favorite food – and small insects, frogs, reptiles, and baby birds of other species. Research

revealed that the bill helps modify blood flow and regulate body heat. Toco toucan can be seen in many zoos and is common in the wild.



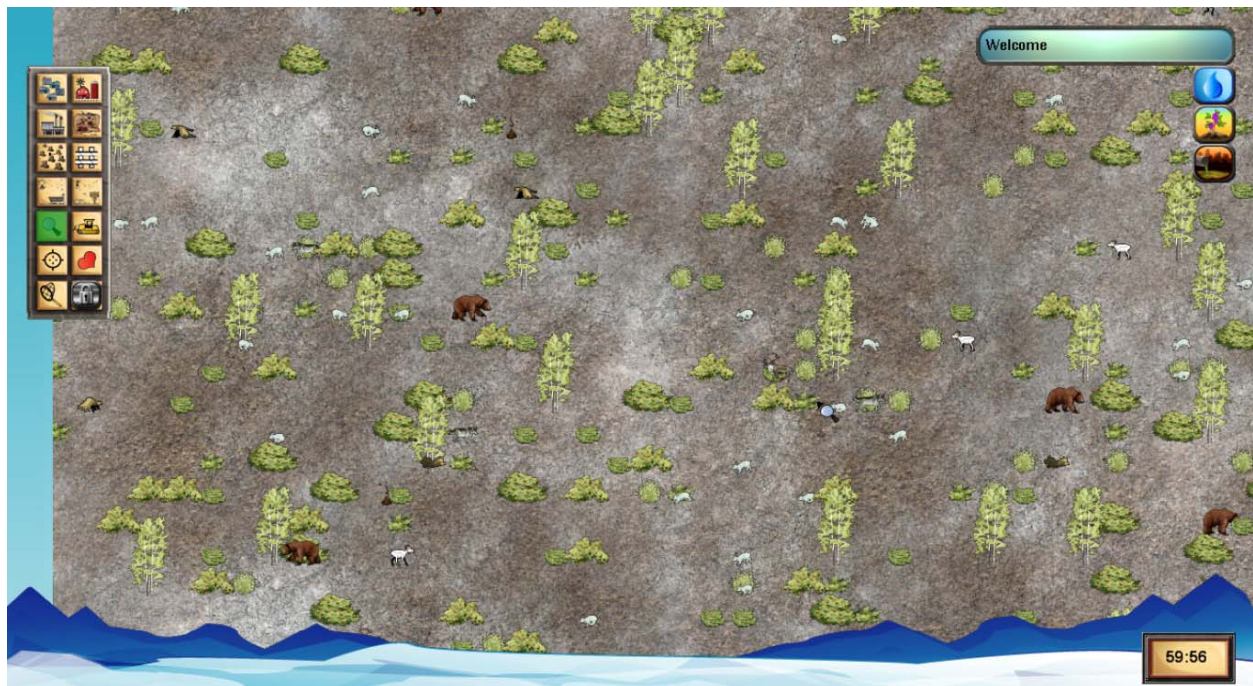
White-lipped Peccary

Tayassu pecari

The white-lipped peccary looks very much like a pig, however, peccaries evolved in the Americas while pigs are native to the Eastern hemisphere. This species lives in the rainforests and dry chaco scrub of Central and South America. A herd of fifty to more than 300 white-lipped peccaries travels together and forages for plant materials and invertebrates. One white-lipped peccary can pose a danger when threatened, and a whole herd can be so aggressive that they have been known to kill jaguars and even people.

Tundra (Alaska)

The tundra is located near the North Pole, making it one of the coldest of all biomes. It is dominated by low-growing plants like shrubs, mosses, liverworts, and grasses. These 1,700 species of plants have adapted to growing seasons that are only 50-60 days long, cold temperatures that dip below -30 degrees Celsius, poor-quality soils, and low light conditions that are inadequate for most tree growth. Tundra vegetation provides food for many herbivores including lemmings, hares, and caribou, which in turn is a source of protein for predators like wolves and bears. Despite adaptations, many animals migrate south during winter.



Aspen

Populus grandidentata

Aspens are actually a group of medium-sized, deciduous trees (which are trees and shrubs that shed their leaves seasonally), that include species such as the white poplar. They tend to grow in cool regions in the Northern Hemisphere and high altitudes in the Southern. In the fall, they are conspicuous because their foliage changes into brilliant tints of red and yellow. Because aspen wood has low flammability, it is used for making matchsticks and packing material.



Caribou

Rangifer tarandus

Caribou, or reindeer, is a Holarctic species that is widespread around the northernmost regions of the globe. Wild populations of caribou have fluctuated historically, but today, many herds are in decline due to habitat loss and climate change. The warming temperatures are especially significant because it alters the abundance and types of plants at faster rates

than herds can adapt their foraging behaviors. In addition, the caribou's ability to survive in extreme cold offers protection from animals that hunt them, but warmer climates allow more predators to encroach further north.



Cotton Grass

Eriophorum angustifolium

Cotton grass belongs in the sedge family, a group of plants with about 4,000 different species that look like grasses. The flowering stem of cotton grass produces three to five inflorescences, which are a cluster of flowers, that have tufts of cotton-like fibers rather than petals. It grows in acidic wetlands and peat bogs, therefore the cotton grass can serve as helpful flags to warn hikers of potentially dangerous bogs. Perhaps that is why the cotton grass is the official county flower of the Manchester region of the United Kingdom.



Dall's Sheep

Ovis dalli

The Dall's sheep is native to arctic and subarctic regions of North America. It is white to slate-brown in color. Both males and females have horns, although the rams have horns that are much larger, flared, and curved to a circle - making them trophy animals preferred by sport hunters. This mountain-dwelling sheep forages on grass, mosses, and lichens. In turn, they are preyed upon by grizzly bears and wolves, sometimes smaller sheep are hunted by golden eagles.



Golden Eagle

Aquila chrysaetos

Golden eagles have a Holarctic distribution, which means that they are found across all continents in the northern hemisphere. With an average wingspan of six feet and weight of 7.5 pounds, it is the largest raptor (bird of prey) in North America. They hunt a variety of animals from rabbits and squirrels to much larger prey like seals, sheep, and deer. They are highly competent predators that have been observed hunting in pairs to catch other large birds, like cranes, in flight.



Grizzly Bear

Ursus arctos horribilis

Grizzly bears inhabit tundra terrains of western North America, usually along rivers and coasts where one of its favorite food, salmon, is available. They are one of the largest bear species, but individuals vary in size and color. Despite their resemblance to the teddy bear, grizzlies are one of the more aggressive bear species, especially if they become used to people and associate campgrounds and trash receptacles as a source for food. Due to habitat loss, grizzlies are considered threatened by the United States Fish and Wildlife and endangered in Canada.



Lady Fern

Athyrium filix-femina

The lady fern is a deciduous, perennial plant native to the United States that grows two to five feet in height and prefers cool, moist soil in the shade. A hardy and graceful plant, it is cultivated in gardens and as ground cover. The lady fern is a member of a very ancient family of plants that have been around since 360 million years ago, each species of which has very specific environmental conditions. Thus, ferns are good indicators of the health of an ecosystem.



Naugehyde Liverwort

Ptilidium pulcherrimum

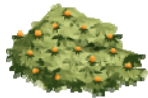
Also known as 'lovely fuzzwort,' the Naugehyde liverwort is a member of a very ancient group of small, nonvascular plants that are similar to mosses and reproduce by spores rather than seed. It grows in very dense patches of yellowish green to reddish brown colors. The leaves have three to five feathery lobes, shaped like miniature hands. Although people do not find much use for this little plant, it is very important ecologically because it facilitates decay of dead trees and disintegration of rocks, and serves as food for grazing animals.



Red Raspberry

Rubus idaeus

Contrary to its name, a raspberry is not a true berry, but is a compound fruit made up of about 100 individual fruits, or drupes. Raspberry is a commercially important plant cultivated for the fresh fruit market and used as an ingredient in many grocery products. Its leaves are used in herbal and medicinal teas because they contain high concentrations of vitamins and minerals that effectively boost the immune system of mothers-to-be, a use that dates back to Native Americans. Raspberry flowers are a source of nectar for honeybees and other pollinators.



Salmonberry

Rubus spectabilis

A relative of the blackberry, the salmonberry is an edible shrub that produces fruit similar to the raspberry. It is native to the Pacific northwest of North America and naturally thrives in streambeds of the temperate rainforests, where it provides food and cover for birds. Gardeners favor the salmonberry bush for its beauty and attractiveness to hummingbirds. But it can grow so fast and thick that it has the potential to become an invasive species, as has happened in the United Kingdom.



Snowshoe Hare

Lepus americanus

The snowshoe hare is adapted for survival in cold, snowy climate. Its feet is broadened for greater surface area and padded with thick fur to enable the hare to move quickly on top of snow. Each winter season, the snowshoe hare molts, or sheds, its brown fur and replaces it with a white coat in order to camouflage into the winter landscape. Even so, keen predators like eagles, wolves, mountain lions, and even people rely on snowshoe hare for food.



Timber Wolf

Canis lupus

The timber wolf is a keystone predator, which means that it plays a very important role in the ecosystem. Its direct impact of this intelligent and social canine is maintaining populations of prey animals in numbers that the habitat can sustain, as well as weeding out the unhealthy individuals. Studies show that wolves have an indirect benefit to ecosystems; they allow the number and diversity of trees and plants to increase by keeping their herbivorous prey animals in check.