

BIODIVERSITY LOSS IN URBAN AREAS

With a focus on the Twin Cities area



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Table of Contents

Slide 1: Title slide

Slide 2: Table of contents

Slides 3-10: Global biodiversity

Slides 11-33: Biodiversity in urban areas

- Slides 11-17: Overview

- Slides 18-19: Environmental justice

- Slides 20-24: Solutions

- Slides 25-28: Factors to consider when attempting to conserve biodiversity

- Slides 29-32: Examples of biodiversity restoration in urban areas

- Slide 33: Conclusion

Slide 34: Resources to learn more

Slide 35: Sources

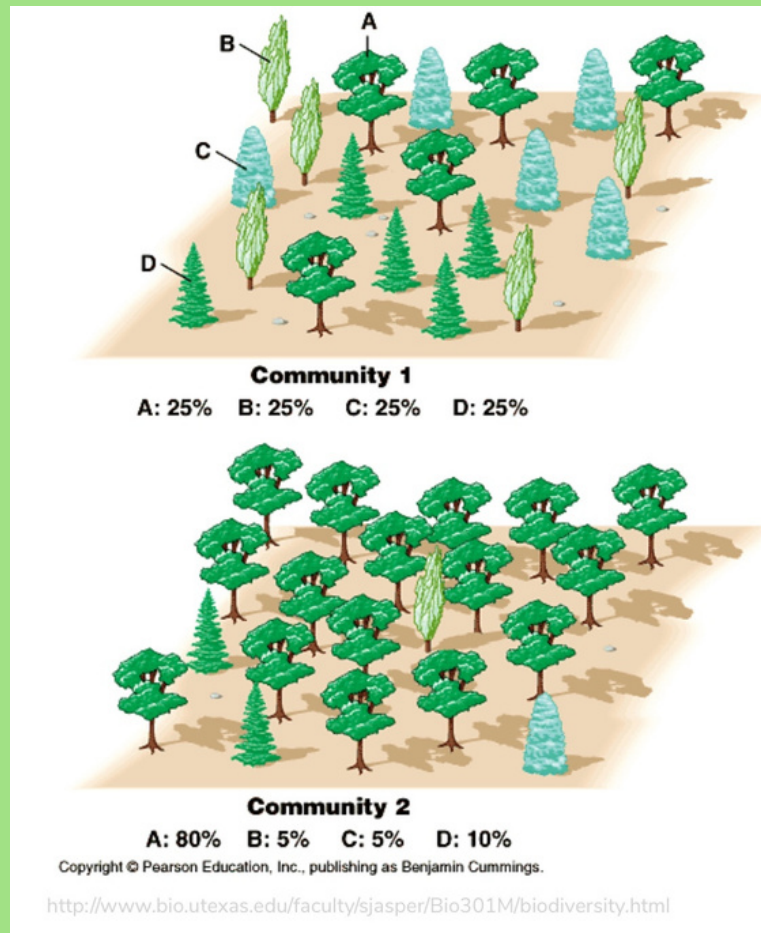
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OVERVIEW OF GLOBAL BIODIVERSITY LOSS

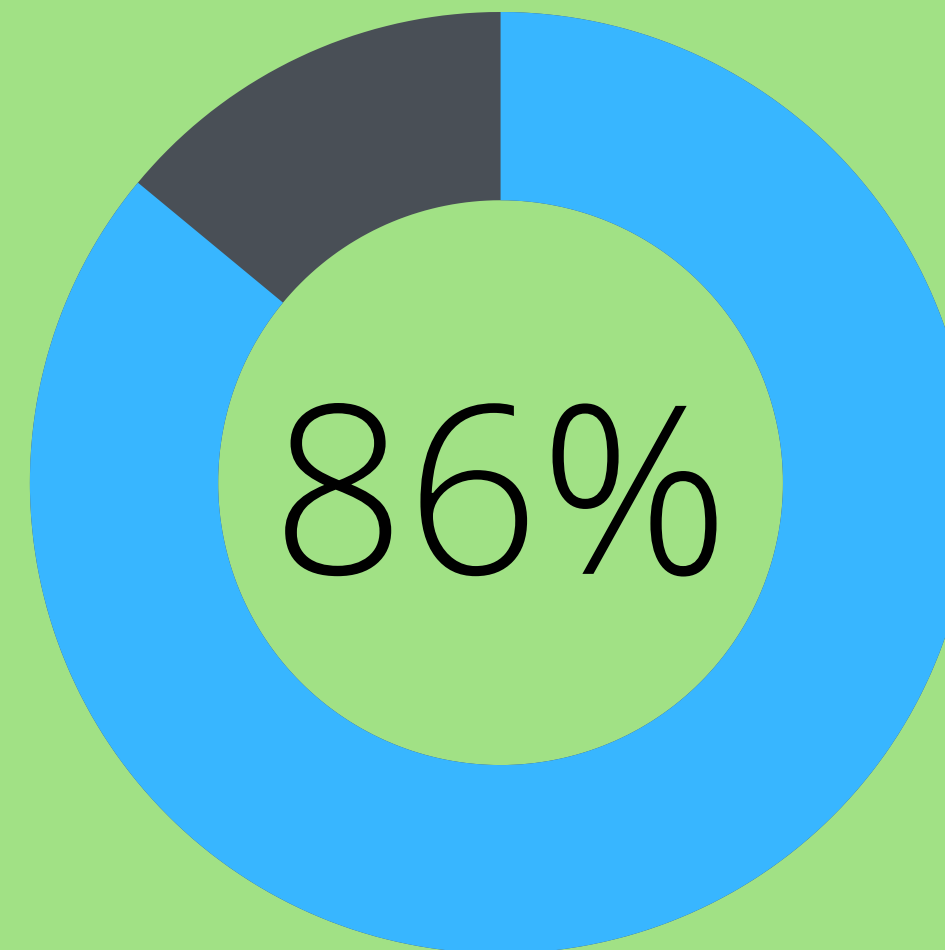


What is biodiversity?

Biodiversity, short for biological diversity, is the variety of life in the world. It includes the genetic variety between individuals of the same species, the amount of species within an ecosystem, and the variety of ecosystems on the planet. The diversity of species in an ecosystem is measured by species richness (the number of species in an area) and species evenness (the relative proportion of individuals within each of the different species in an area). An area with many different species and where all the species contain roughly the same number of individuals has high biodiversity. Scientists estimate that there are currently around 8.7 million species on earth, and only about 1.2 million of them have been identified.



Although communities A and B have the same number of species, community A has higher species diversity because it has higher species evenness



of species are currently unidentified

Why is biodiversity important?

Biodiversity is important because of the services ecosystems provide. The greater the biodiversity, the more services provided.

There are five main ecosystem services:

Provisions:

Goods that humans can use directly.
Examples: lumber, food crops, medicinal plants, natural rubbers, furs.

Regulating services:

Regulate environmental conditions.
Examples: removing carbon dioxide and producing oxygen, biogeochemical (water, carbon, nitrogen, phosphorus, and sulfur) cycles.

Support

services: Allow other ecosystem services to happen and species to thrive.
Examples: pollination, water filtration.

Resilience:

Allows an ecosystem to remain in its current state, thus allowing other ecosystem services to happen. It depends greatly on species diversity. Example: if a disease killed one nitrogen-fixing plant species (which provide essential nutrients for other vegetation), but there were other nitrogen-fixing plant species, the ecosystem could continue to function.

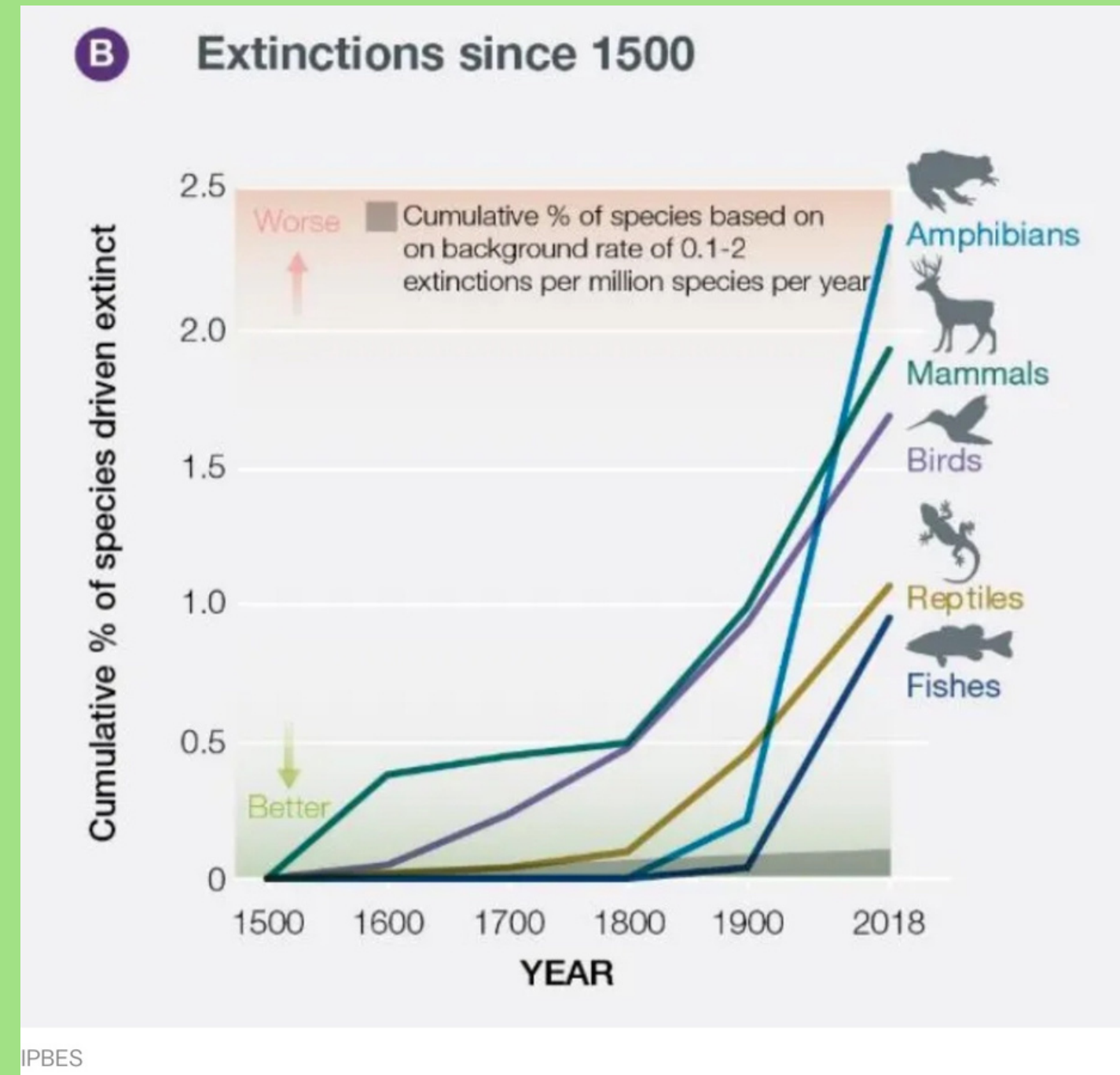
Cultural services:

Natural aesthetic beauty that people are willing to pay to preserve. Example: governments are willing to pay to create and maintain national parks, and citizens are willing to pay fees to visit these park.

It is estimated that ecosystem services are worth over 30 trillion dollars per year.

Global biodiversity is greatly declining

By analyzing the fossil record, scientists estimate that approximately 0.1 species per every million naturally go extinct each year. Scientists have concluded that the annual extinction rate is now around 100 species per million, which is similar to the rates experienced during the five past mass extinctions.



We are currently experiencing a Sixth Mass Extinction.

Why biodiversity loss is important

Planetary boundaries, illustrated in the figure to the right, are proposed quantitative limits for the nine processes that regulate nature's stability and resilience, within which humanity can continue to thrive for the long term. If these boundaries are crossed, the risk of large-scale, abrupt, and irreversible environmental changes increases.

As you can see in the figure, biodiversity loss (measured in extinctions per million species per year (E/MSY)) is exceeding its planetary boundary at one of the highest rates. This is why many scientists consider biodiversity loss to be just as great of a threat to the future of humankind as climate change. For example, research has shown that future biodiversity loss has the potential to decrease plant production just as much as climate change and pollution.



Causes for global biodiversity loss

1) Habitat loss (main cause)

- Human development is the main contributor to this. Our destruction of forests and coral reefs is the biggest problem.
- Habitat degradation also greatly contributes to biodiversity loss by decreasing the amount and quality of resources that species depend upon for survival within their habitat.
- Habitat fragmentation (dividing a habitat into smaller sections via an artificial barrier, such as a road through a park or a dam on a river) also greatly contributes to biodiversity loss by decreasing the area of habitat available to species, decreasing the number of available mates, and making it more difficult for migratory species to find places to rest and feed along their migration routes.



2) Invasive species

- When species accidentally get transported to foreign locations or are brought to a new location via the exotic pet trade, they can spread rapidly and form large populations because they have no natural enemies. This causes them to outcompete other species or act as predators towards them, thus contributing to the decline of many native species.
- Examples: kudzu vine, zebra mussel, silver carp

3) Over-harvesting

- Occurs when humans remove animals from the environment faster than they are replaced, due to hunting, fishing, the plant and animal trade, etc.
- Examples of over-harvested species: dodo birds, mammoths, passenger pigeons

4) Pollution and diseases

- Pesticides, heavy metals, acids, oil spills, excess nutrients (specifically nitrogen and phosphorus), thermal pollution, noise pollution, air pollution, diseases like white-nose syndrome in bats, and many other factors can cause species to decline or go extinct.

5) Climate change

- Some species are unable to survive in or adapt quickly enough to changed climatic conditions, such as higher temperatures, or are eliminated from the environment due to increased occurrences of natural disasters.

Solutions for global biodiversity loss

Svalbard Global Seed Vault: A facility located in Norway to store the seeds of many plant species, in case any of them were to go extinct.



The Convention on Biological Diversity (CBD): A 1992 international treaty to help preserve biodiversity.

- Three goals: conserve biodiversity, sustainably use it, and equitably share the benefits of commercial use of genetic resources.
- In 2002, CBD developed a plan to decrease biodiversity loss by 2010. This plan ultimately failed, and biodiversity continues to decline today. However, CBD has made significant contributions regarding the reduction of global biodiversity loss, and therefore its work is still very important in conserving biodiversity.

Solutions for global biodiversity loss

continued: legislation

Most focuses on a single species

- Invasive species: Legislation may include inspecting incoming goods or banning wooden packing crates to prevent the spread of invasive species.
- Plant and animal trade: Legislation includes the Lacey Act (a US ban on the interstate shipping of illegally harvested organisms) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)(a treaty to control the international trade of threatened species), which includes the Red List (a list of worldwide threatened species that each member country of CITES monitors and regulates).
- Marine Mammal Protection Act: A US act that bans the killing and trade of marine mammals.
- Endangered Species Act: A US act that bans the harming of threatened or endangered species.

Some legislation focuses on whole ecosystems by creating biosphere reserves (protected areas with several zones that each allow different types and amounts of human impact), which are also used to research solutions to biodiversity loss:

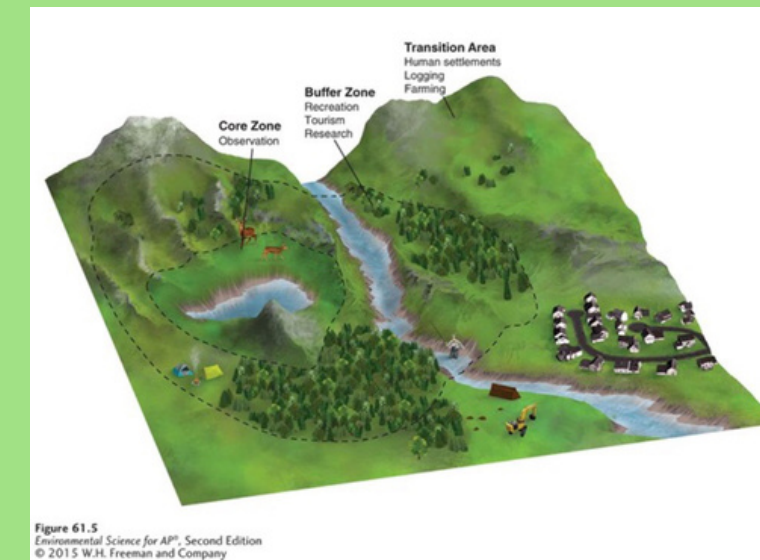


Figure 61.5
Environmental Science for AP®, Second Edition
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When attempting to conserve biodiversity, it is important to remember that we need to use the benefits of ecosystem services in order for our society to continue to function. Conserving biodiversity is about finding a way to continue to use these ecosystem services for as long as possible in a way that does not decrease the world's biodiversity.

BIODIVERSITY AND URBAN AREAS



Biodiversity declines due to the presence of urban

Here are some of the reasons why:

1. Impermeable surfaces, such as parking lots, roads, and sidewalks, which cover much of the land in urban areas, prevent water from soaking into the soil below. This prevents plants from being able to grow and increases the chance of flood, which can kill wildlife and contaminate local water bodies with harmful pollutants.
2. Many natural areas are eliminated or become much smaller due to the development and expansion of cities. Some types of species require large areas of natural land, and therefore are unable to survive if their habitat size decreases.
3. Natural areas within cities are often surrounded by developed land, thus isolating them from other natural areas. This causes biodiversity loss according to the Theory of Island Biogeography (more on this later). If the connections between isolated natural areas are also destroyed, this further decreases biodiversity (more on this later).
4. The edge effect (more on this later).

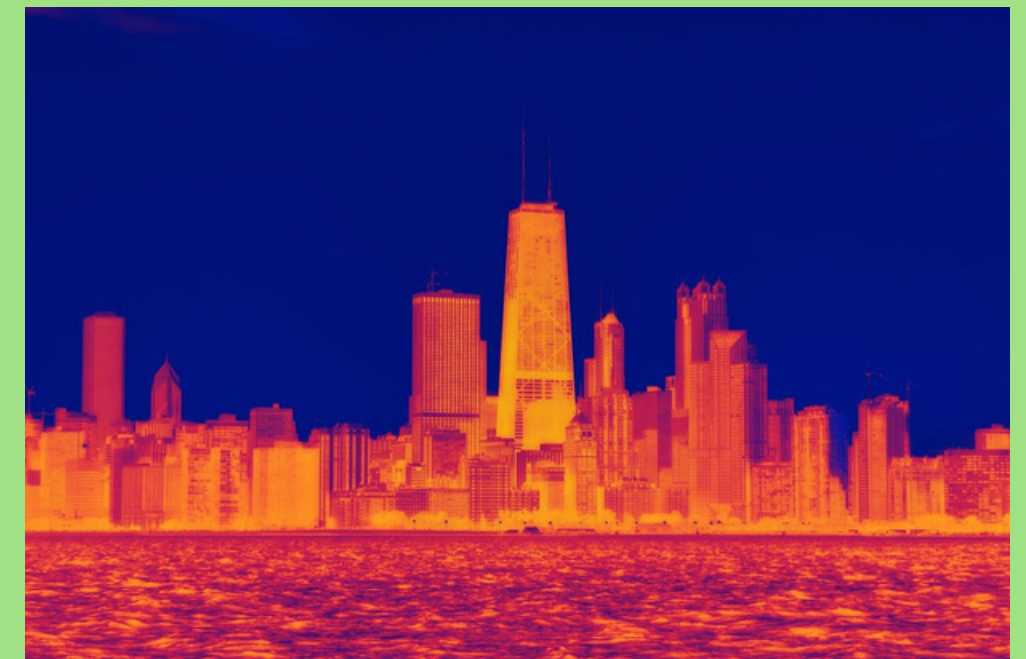


Causes of biodiversity loss in urban areas continued

5. Increase in invasive species (often weeds). Invasive species often do best in full sunlight, which allows them to thrive in urban areas because there are typically less trees, which provide shade, in cities than in the wild. Invasive species take nutrients, water, and space away from native species, thus causing the native species to decline.

6. All types of pollution can directly or indirectly kill wildlife. Pollution increases in urban areas due to their large human populations.

7. The urban heat island effect, which describes the fact that replacing vegetation with pavement and buildings causes the temperatures in urban areas to increase, since pavement and buildings absorb more heat than vegetation does. Since some species that previously lived in cities cannot survive in higher temperatures, this causes such species to become extinct within urban areas.



Urban sprawl increases biodiversity loss by expanding urban areas

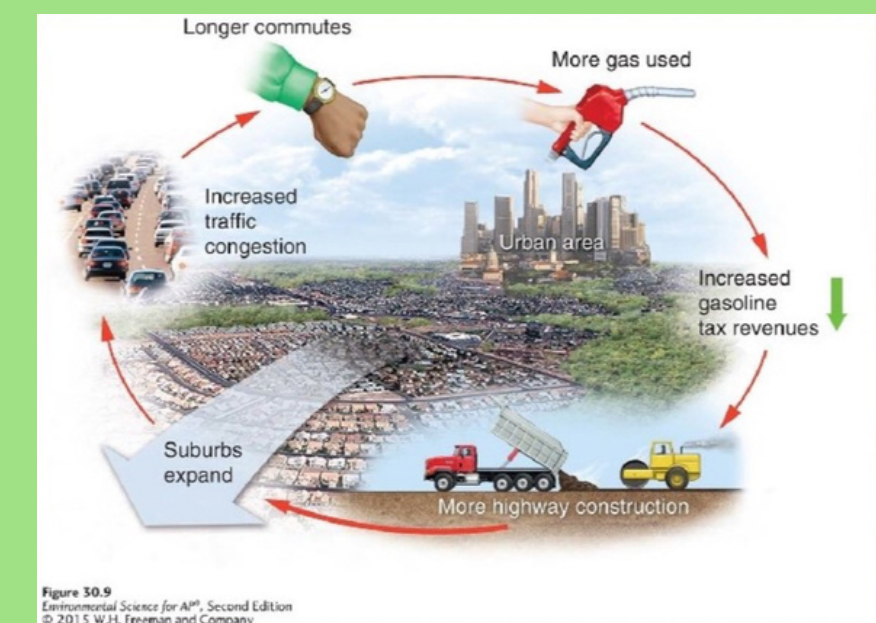
Urban sprawl is the unnecessary expansion of urban areas into their surrounding landscapes, including the creation of suburbs. Causes of urban sprawl include:

1. Highway construction and use of cars, which allow citizens to quickly transport themselves between the suburbs and the city, thus encouraging the expansion of suburban areas.
2. The cost of living is often less expensive in the suburbs because land is readily available.
3. Urban blight (the decline in the quality of urban areas over time), which not only leads to biodiversity loss by contributing to urban sprawl, but also by decreasing the amount of money cities have to spend on conserving biodiversity.
4. Government policies such as the Highway Trust Fund, single-use zoning (which means that certain areas of land are only allowed to be used for one specific purpose, which prevents offices, stores, and schools from being located near homes, thus encouraging the use of cars and highways, which leads to urban sprawl), and the GI Bill (which allows working-class veterans to be able to afford houses in the suburbs).

Cycle of urban blight:



The Highway Trust Fund's contribution to urban sprawl:

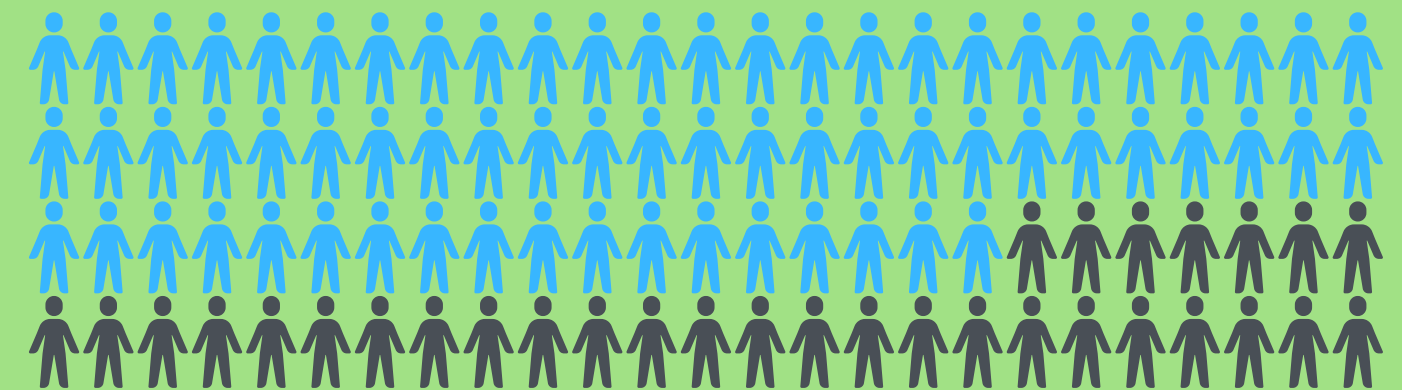


Why biodiversity is important to have in urban areas:

People need clean water and air to live, and ecosystems filter our air and water. The healthier, bigger, and more biodiverse the ecosystem, the more filtration. Having clean air and water is especially important in urban areas because the majority of the world's population lives in cities, including about 73 percent of Minnesotans, with about 55 percent of Minnesotans living in the Twin Cities.



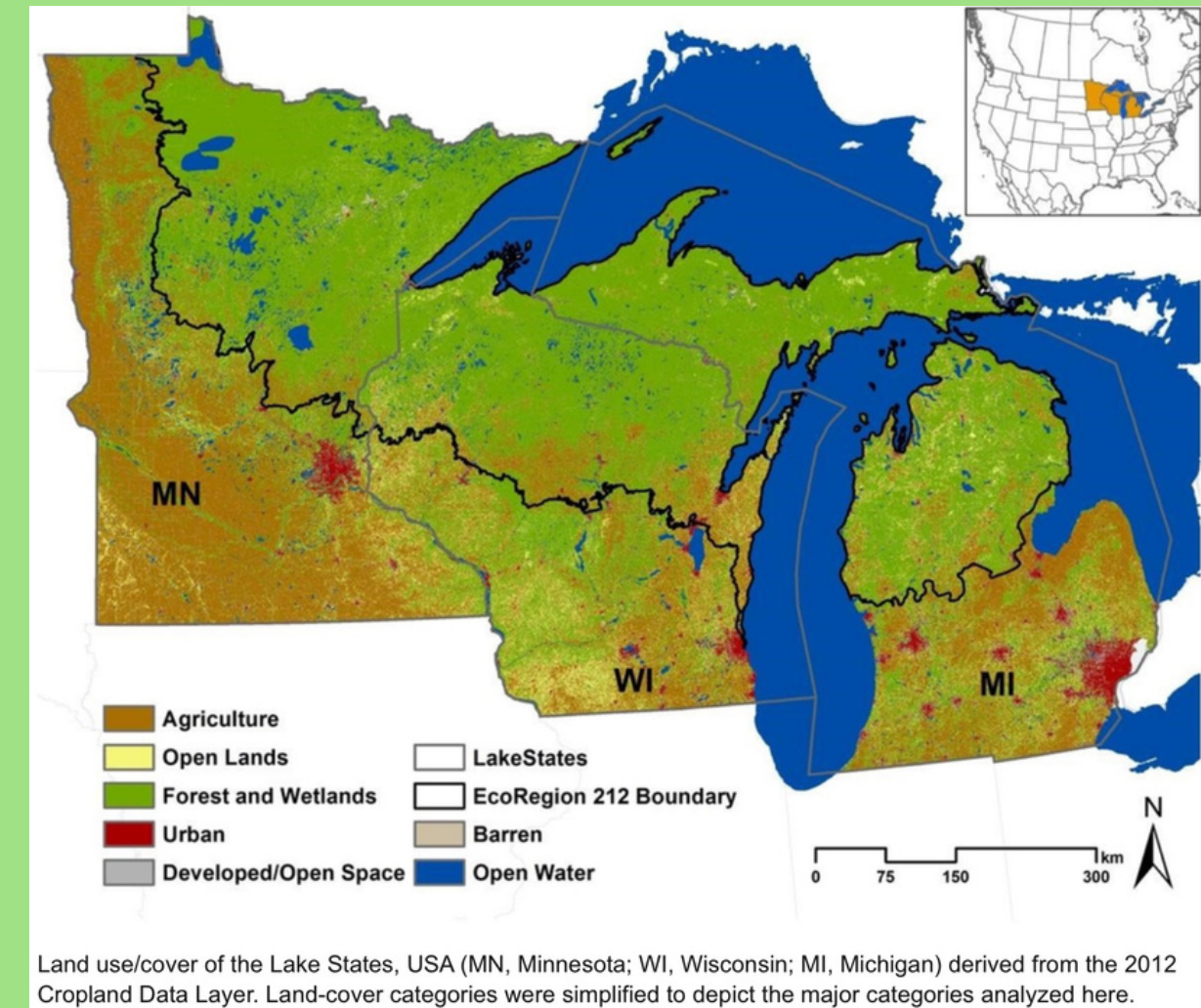
55% of the world's population lived in urban areas in 2018



68% of the world's population is expected to live in cities by 2050.

The areas surrounding an urban area have a huge impact on the biodiversity of that urban area

- If an urban area is surrounded on all sides by natural, healthy, undeveloped ecosystems, then species that live in this area will be able to easily move into the city and populate its parks and natural areas, thus increasing the biodiversity level of the city. If a city is surrounded by agricultural fields or industrial areas, which both contain very little biodiversity, few species will migrate to the city from its surrounding areas, thus making it difficult for that city to develop much biodiversity.
- Even if a city is not surrounded immediately or entirely by natural areas, it may still develop high levels of biodiversity if there is a large natural area nearby, according to the theory of island biogeography (more on this later).
- Cities surrounded by areas of low biodiversity will likely experience the edge effect (more on this later) in any natural areas within the city, thus further decreasing their biodiversity levels, while cities surrounded by wilderness will contain much less edge habitat and thus much more biodiversity. Therefore, in order to conserve biodiversity in urban areas, it is important to keep the areas surrounding cities natural, which includes reducing urban sprawl.



The Twin Cities are mostly surrounded by agricultural regions, thus making it difficult for the Twin Cities to develop more biodiversity. However, the cities do have some relatively small natural areas located nearby (mostly forests and wetlands), which may help increase their biodiversity.

Surprising biodiversity

It is important to note that some places in urban areas, such as parking lots and buildings, contain almost no biodiversity, while other areas, such as parks and nature preserves, can be surprisingly diverse. For example, a wide variety of waterbirds (loons, grebes, pelicans, cormorants, herons, egrets, cranes, tern, gulls, ducks, geese, swans, and sandpipers) have been observed in Saint Paul and Minneapolis along the Mississippi River, and a variety of species, from great-horned owls to woodchucks and foxes, are seen in Central Park in Roseville.

Woodpeckers, bats, deer, raccoons, and many more wild animals are seen on residential properties. It is amazing that such a wide variety of species are able to exist in an urban area like the Twin Cities, despite all the challenges they face!



Environmental justice

Poor and minority communities

When exploring the loss of biodiversity in urban areas, it is important to consider the fact that the loss of biodiversity, and thus the decline of ecosystem services, occur at a higher rate in poor and minority communities. These communities often have less power and influence over industries and governments that harm the environment, which is why higher rates of environmental degradation, which leads to biodiversity loss, occur in poor and minority communities. An example of this is when much of the Rondo neighborhood, home to a mainly black community in Saint Paul, was destroyed in 1956 to build the Interstate 94 highway. This caused over 600 African-American families to lose their homes, and biodiversity to decline in the region as a result of the noise and air pollution created by the highway.

Poor and minority communities often live near the center of urban areas, while rich white communities generally live in the suburbs. Since biodiversity loss is generally greatest closest to densely populated and highly developed city centers, this means that poor minority communities will experience lower levels of biodiversity in their neighborhoods than wealthy white communities that can afford parks and other features that conserve local biodiversity. Although the cost of living in the suburbs is often less than living in or near the city, some poor families may not be able to afford to move to the suburbs, forcing them to remain in areas with very low levels of biodiversity. The cycle of urban blight causes biodiversity in city centers to further decline.

Communities that experience increased rates of health issues due to local environmental concerns also generally have lower levels of biodiversity. For example, water and soil pollution from a mine may cause disease in both human and wildlife populations nearby, thus contributing to a decline in human health as well as biodiversity.

Biodiversity loss harms these communities in many ways. The decline of plant species prevents adequate filtration of local air and water, thus further degrading residents' health. Decreasing biodiversity also causes natural spaces in these neighborhoods to decline in quality, thus preventing these communities from being able to enjoy them.



Environmental justice continued

Indigenous communities

Indigenous communities, such as the Dakota people in the Twin Cities area, have experienced great biodiversity loss on their lands due to European colonialism. Indigenous peoples worked very hard and were very successful at maintaining high levels of biodiversity on their lands for centuries before the arrival of white settlers. When these European colonizers arrived, they took the indigenous peoples' land away from them and began to degrade it for their own economic gain, especially in areas with high quantities of valuable natural resources, which they later built cities around. For example, settlers created the Twin Cities along the Mississippi River because they wanted to exploit the river's potential as a transportation network, and took and degraded the Dakota people's land in order to do so. The actions of settlers severely depleted the amount of biodiversity on indigenous lands. Although some recent efforts to restore and return these lands to the indigenous populations have been successful, the level of biodiversity on native lands is still nowhere near where it was before the arrival of white colonizers.



Solutions to biodiversity loss in urban areas

Important concepts to keep in mind:

For some species, there is not much we can do to increase their presence in urban areas. For example, it is almost impossible to create larger expanses of grassland in urban areas for birds that require it. Some species are simply not able to survive in urban areas, so urban areas will almost always be less biodiverse than natural areas. However, we can still increase biodiversity in cities by ensuring that species that are able to live in urban settings have all the resources they need to thrive.

Because biodiversity loss is such a big issue and is impacted by so many other factors, almost all actions that have environmental impacts also affect biodiversity. This means that there are many solutions to biodiversity loss, but also many steps that must be taken to prevent further loss, which makes it both relatively easy and hard to conserve biodiversity.

Solutions to biodiversity loss in urban areas

Solutions include but are not limited to:

- Decreasing water pollution. This can be done by keeping the areas around surface water bodies natural by not developing right up to the water's edge (because this increases the amount of pollution running off from adjacent developed land into the water, destroys habitat, and prevents soil and plants from filtering pollutants out of the water before they run into the water body). We can also limit water pollution by decreasing the amount of impermeable surfaces and by keeping wetlands (which filter water and provide key habitat to many struggling species) or building rain gardens (which filter out pollutants in the water that runs off of developed land before it reaches a storm drain) in urban areas. Local organizations, such as the Friends of the Mississippi River in the Twin Cities, can also reduce water pollution by stenciling messages around storm drains that encourage local residents to keep pollutants out of them.
- Environmental organizations paying more attention to and putting more work into conserving biodiversity in urban areas.
- Programs like Metro Conservation Corridors in the Twin Cities that work to create and maintain corridors (more on this later), protect and restore habitat, create buffers (gradual transitions) between urban and natural areas, and increase the accessibility of natural recreation areas.
- Decreasing the number of roads and cars by increasing public transportation services.
- Protecting remaining habitat and increasing the amount of habitat. For example, not removing plants that grow in shallow water, because they provide habitat.
- Reducing plastic usage, since plastic can kill animals if they swallow or get entangled in it.
- Allowing beekeeping on residential properties, like the City of Falcon Heights is currently working towards.
- Further research on biodiversity, which will allow us to better understand it in order to come up with more effective solutions.



Solutions to biodiversity loss in urban areas

Solution to urban sprawl: smart growth

Smart growth: an approach to urban development that aims to decrease urban sprawl and other types of environmental degradation. There are ten main ways to do this:

1. Create mixed land uses
2. Create a variety of housing options
3. Create walkable neighborhoods
4. Encourage community collaboration in environmental decisions
5. Design compact buildings - build upwards, not outwards
6. Create a strong sense of community within and connection to the city
7. Preserve natural areas
8. Create quality public transportation services and locate buildings near these services
9. Direct development towards existing communities
10. Make decisions about the city's development fair, predictable, and cost-effective



What local citizens can do to improve biodiversity in urban areas

Solutions include but are not limited to:

- Decreasing water pollution by cleaning storm drains so pollutants don't get into lakes and rivers and by limiting the use of nitrogen and phosphorus fertilizers (which can kill many aquatic animals if they run off local water bodies).
- Planting a variety of native plants instead of grass in our yards. This increases lawns' biodiversity and supports pollinators, which are important because they boost the production of about 75 percent of plant species, thus further elevating biodiversity levels. Note: It is important that the plants are native because many non-native plants have inferior nectar and pollen resources for pollinators.
- Becoming a beekeeper
- Using public transportation instead of driving.
- Using less plastic, properly disposing of plastic, and picking up litter.
- Volunteering to help restore natural areas or collect local biodiversity data, with organizations such as the Department of Natural Resources



Industrial and governmental policy vs. individual action

Although individual action, such as planting native flowers and taking public transportation, is important in preventing further biodiversity loss in urban areas, much of the damage is being done by industries (example: producing pollution) and governments (example: creating the Highway Trust Fund). Therefore, it is arguably more important for industries and governments to pursue policies that conserve biodiversity than for individual citizens to take action. For example, the Friends of the Mississippi River and a coalition of other organizations are working together to create legislation that will decrease the use of chloride as a de-icer in Minnesota (which can reduce aquatic populations by increasing the salt concentration of water bodies), which is likely going to be more effective than encouraging individual citizens and businesses to reduce their chloride usage instead. Another example is how the industries that manufacture plastic products and the governments that allow these industries to continue producing plastic are the ones responsible for plastic pollution, not the citizens who use their plastic products (who often live in poverty and are unable to afford alternatives to plastic). Thus, if individuals want to do their part to decrease biodiversity loss, a critical step to take is to encourage industries and governments to conserve biodiversity.



Factors to consider when conserving habitat in urban areas in order to increase biodiversity:

- 1 Theory of island biogeography
- 2 Metapopulations and corridors
- 3 Edge effect

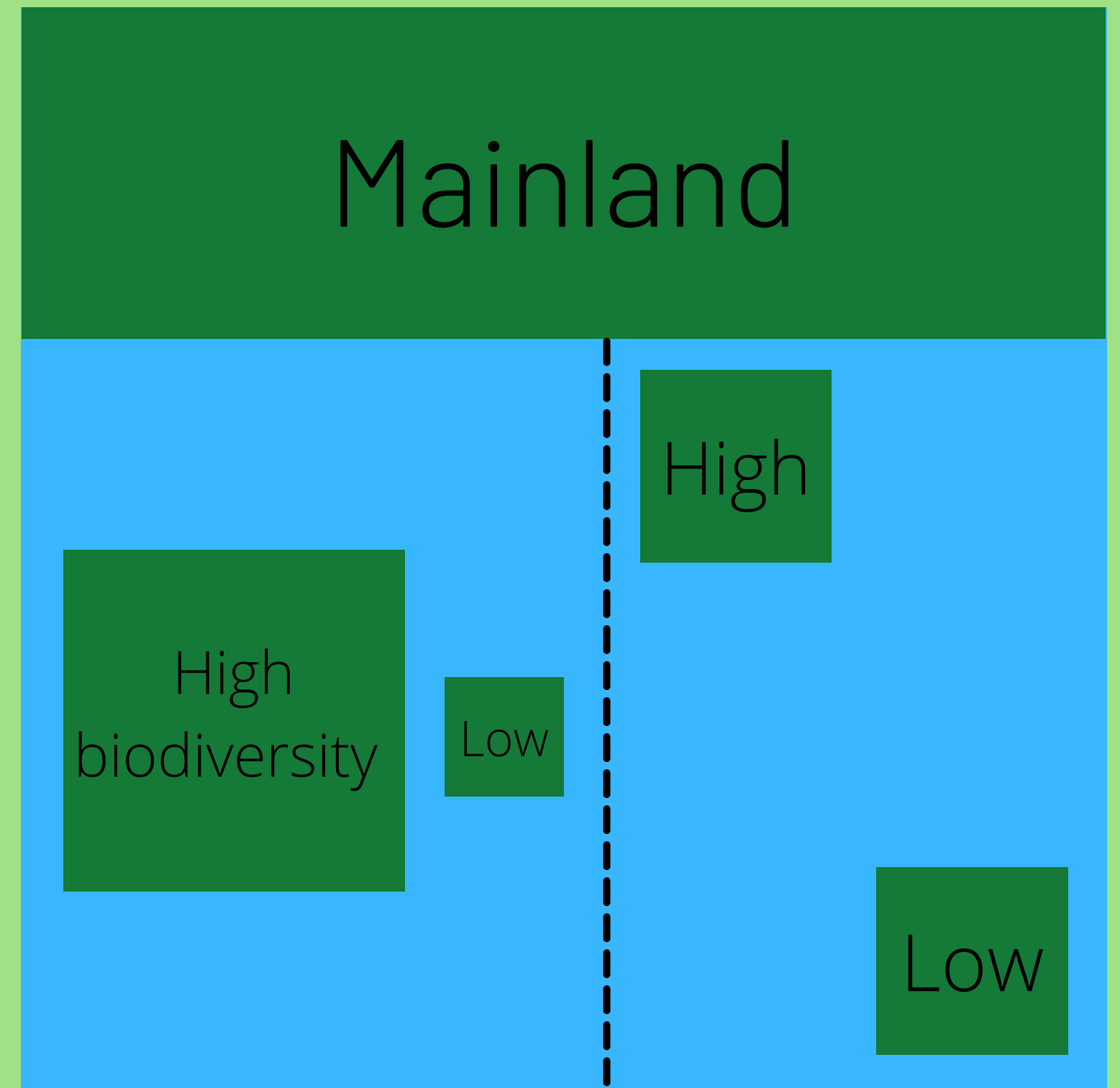


Theory of island biogeography

This theory states that a) the larger the habitat size, the higher the number of species and b) the lower the distance between the species that colonizes a habitat and the habitat itself, the higher the number of species.

Thus, most conservation should occur in larger areas closer to possible colonizers.

This theory originally only applied to islands, but now applies to areas of habitat surrounded by developed lands, including parks and other natural areas within cities.



Metapopulations and corridors

Metapopulation: a group of populations that are all located in different areas but are connected by individuals occasionally moving between the populations.

Corridor: an area of natural habitat that connects populations, thus forming metapopulations.

It is important to keep metapopulations connected because doing so increases genetic diversity and recolonizes areas where one population went extinct. Therefore, creating and maintaining corridors is an important step in conserving biodiversity in urban areas.



The edge effect

Edge habitat is the area of a natural habitat that borders a different type of landscape, with a sharp transition existing between the two, such as an agricultural field or a building.



Edge habitat is unnatural, because in the wild, there would be a gradual transition between two different types of habitat. In some habitats, such as a forest, environmental conditions may be altered up to 300 feet from the edge due to there being a sudden transition between two different types of landscape.

Since most parks and nature preserves in urban areas are located right next to developed land with no transition between the two, much of the habitat in urban areas is edge habitat.

Edge habitat favors some species and disfavors others. For example, edge habitat is often not shaded due to a lack of trees on the land adjacent to it, thus benefiting plants that need full sunlight to grow and harming those that require full shade.

Red-tailed hawks thrive in the edge habitat along highways, and white-tailed deer also greatly benefit due to the edge effect of urban areas. However, species such as the northern goshawk often do not survive in edge habitat because they require large tracts of interior forest land.

Additionally, due to the altered environmental conditions of cities, species with high tolerances to changes in environmental conditions are more likely to do well in urban areas, while species with specific needs, such as a nocturnal bat species that only forages at a certain time of night, may not be able to survive in urban areas.

Therefore, some species, such as sun-loving plants, red-tailed hawks, and white-tailed deer, are more common in urban areas than in the wild, while other species, such as shade-loving plants, northern goshawks, and nocturnal bats, are more common in natural areas than in cities. This results in different species being present in urban areas than in the wild.

In general, edge habitat cannot support as many species as interior habitats or habitats with gradual transitions can. Therefore, an important step in conserving biodiversity in urban areas is creating gradual transitions between developed land and natural areas.

Bridal Veil Open Space

This is a great example of how biodiversity can be restored and maintained in very urbanized areas.



Bridal Veil Open Space is a 6.6-acre area of land located in the City of Minneapolis, surrounded on all sides by industrial properties, developed land, and railroad tracks. Bridal Veil Creek and a wetland are located on the site.

Bridal Veil Open Space

History:



Bridal Veil was originally a wetland area, but was turned into a pond in 1970. It captures runoff from the adjacent industrial properties, and the water in it eventually goes to the Mississippi River.

Bridal Veil is located on a Superfund site (Superfund is a US Act that allows the EPA to clean up contaminated areas). The surrounding industrial properties contaminated Bridal Veil with pentachlorophenol (PCP) and a variety of other chemicals. Although signs encouraged the public to stay off the site because exposure to the contamination posed a significant human health risk, many people still came to Bridal Veil for recreational purposes. Therefore, the Minnesota Pollution Control Agency recommended in 2007 that the site be restored. The local community wanted to conserve the biodiversity of the region, in order to support local wildlife and continue to enjoy the area for recreational purposes, and thus had a direct impact on its remediation.

In following years, the Southeast Como Improvement Association and the Minnesota Pollution Control Agency worked together to restore this site in a way that greatly increased its biodiversity:

- They decided to keep a water body on the land in order to promote biodiversity, but chose to make it a wetland again instead of a pond so that people wouldn't continue to swim in the contaminated water.
- The water closest to the industrial properties is still quite contaminated, but as it flows towards the street, sunlight breaks down the PCP, and thus, the decontamination of the water is done entirely through natural processes. By the time the water reaches the street, it only contains ten percent of the PCP that it does closest to the industrial properties and is able to meet water quality standards.
- A mechanical device located underground next to the pond catches sediment and prevents it from flowing into the wetland. This prevents biodiversity loss by reducing sedimentation, which can kill fish by clogging their gills with sediment. Sedimentation can also block sunlight from reaching aquatic plants and animals, which prevents plants from performing photosynthesis and predators from being able to see their prey, and also reduces the size of the lake by filling it with sand, thus reducing the amount of habitat for aquatic wildlife populations.
- Landscapers planted a variety of native plants, which provided habitat for many bees, butterflies, and deer. Other plants naturally began growing in the area later on.
- Contaminated soil was covered up with four feet of clean soil, since most plant roots do not go down more than four feet, therefore preventing the loss of plant species in the area.
- The stream that used to run from the nearby railroad to the pond was piped underground in order to decrease water contamination, thus limiting further biodiversity loss.
- Purple loosestrife, an invasive species in Minnesota, previously dominated the Bridal Veil Area, which reduced the populations of native species. However, the restoration workers introduced a beetle species that controls the purple loosestrife population so that very few currently remain in Bridal Veil, thus allowing more native species to thrive.

Bridal Veil Open Space

Summary:

Bridal Veil is now a biodiverse area with levels of PCP that meet water quality standards. Although this site experienced significant environmental degradation, and for some time had almost no vegetation or wildlife and thus very little biodiversity, the story of Bridal Veil proves that nature is resilient and that it is in fact possible to restore biodiversity in an urban area. This is a great example of the power that both humans and nature hold to reverse the damage done to natural places.



Additional examples

Similar to Bridal Veil, these other lesser-known natural areas in the Twin Cities are great examples of nature's resilience despite environmental degradation and show that it is entirely possible to conserve and increase biodiversity within urban areas:

- Trout Brook Nature Sanctuary

<https://www.capitolregionwd.org/projects/trout-brook-nature-sanctuary/>

- Bruce Vento Nature Sanctuary

<https://www.lowerphalencreek.org/bruce-vento-nature-sanctuary>

- Pig's Eye Regional Park

<https://www.twincities.com/2017/10/24/st-paul-biggest-park-nobody-knows-pigs-eye-regional-daytons-bluff/>

Conclusion

The population and development of the Twin Cities area are increasing, with one million more people and 500,000 more households coming to the area in the next 30 years. Almost 60 acres of fields, forests and wetlands are cleared for development every day in the metro area, and this will only increase in the coming decades. These changes will further decrease the biodiversity level of the Twin Cities, which is why it is very important to continue to protect and restore natural areas like Bridal Veil, as well as take other actions, both on the individual and governmental levels, to increase biodiversity in the area, in order to protect our beautiful city and community for generations to come.



Resources to learn more

1. *Racing Extinction*: An incredibly inspiring 2015 documentary that explores the sixth mass extinction.
2. The Minnesota Biological Survey, a program that collects and reports information regarding the biodiversity of Minnesota:
<https://www.dnr.state.mn.us/mbs/index.html>
3. Resources from the Convention on Biological Diversity, such as the following document:
<https://www.cbd.int/doc/health/cbo-action-policy-en.pdf>

Sources

“68% Of the World Population Projected to Live in Urban Areas by 2050, Says UN.” United Nations, 16 May 2018, www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.

“All Minnesotans.” Minnesota Compass, www.mncompass.org/topics/demographics.

“Bruce Vento Nature Sanctuary.” Lower Phalen Creek Project, www.lowerphalencreek.org/bruce-vento-nature-sanctuary.

Dhalleine, Timothy. “10 Movies That Will Make You Want to Protect Planet Earth Right Now.” EcoCamp Patagonia, www.ecocamp.travel/blog/10-movies-that-will-make-you-want-to-protect-planet-earth-right-now.

Dias, Braulio F. S. “The Slow but Steady Progress in the Implementation of the Biodiversity Agenda.” IUCN, 31 July 2020, www.iucn.org/news/world-commission-environmental-law/202007/slow-steady-progress-implementation-biodiversity-agenda.

Duggan, Jennifer. “Norway: 'Doomsday' Vault Where World's Seeds Are Kept Safe.” Time, time.com/doomsday-vault/.

“Ecosystem Effects of Biodiversity Loss Could Rival Impacts of Climate Change, Pollution.” University of Michigan News, 2 May 2012, news.umich.edu/ecosystem-effects-of-biodiversity-loss-could-rival-impacts-of-climate-change-pollution/.

Elliott, Kimberly Kutz. “The Growth of Suburbia.” Khan Academy, Khan Academy, www.khanacademy.org/humanities/us-history/postwarera/postwar-era/a/the-growth-of-suburbia.

Friedland, Andrew J., and Rick Relyea. Environmental Science for AP. W.H. Freeman and Company, 2019.

“Greater MN: Refined & Revisited.” MN State Demographic Center: Department of Administration, 26 Jan. 2017, mn.gov/admin/demography/reports-resources/greater-mn-refined-and-revisited.jsp.

“Habitat Loss.” National Wildlife Federation, www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Habitat-Loss.

“Harriet Alexander Nature Center.” Roseville, Harriet Alexander Nature Center, Roseville Parks and Recreation, www.mncompass.org/topics/demographics.

McClure, Jane. “Rondo Neighborhood.” Saint Paul Historical, saintpaulhistorical.com/items/show/160.

“Metro Conservation Corridors.” Minnesota Department of Natural Resources, www.dnr.state.mn.us/metroconservationcorridors/index.html.

Minnesota Department of Natural Resources. “2020 Annual Volunteer Report.” Minnesota Department of Natural Resources, files.dnr.state.mn.us/volunteering/annualreport.pdf.

Minnesota Pollution Control Agency. “Valentine Clark State Superfund Site – Bridal Veil Open Space Recommended Contamination Response.” July 2007.

“Mississippi River Twin Cities IBA.” Audubon, 10 May 2018, www.audubon.org/important-bird-areas/mississippi-river-twin-cities-iba.

National Geographic Society. “Biodiversity.” National Geographic Society, 5 June 2019, www.nationalgeographic.org/encyclopedia/biodiversity/.

NJ Biology Technical Note: White-Tailed Deer Impacts and Forest Management. United States Department of Agriculture Natural Resources Conservation Service, New Jersey Audubon Society, www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_017980.pdf.

“Northern Goshawk Habitat Model.” United States Fish and Wildlife Service, www.fws.gov/r5gomp/gom/habitatstudy/metadata/northern_goshawk_model.htm.

“Northern Goshawk Identification.” All About Birds, www.allaboutbirds.org/guide/Northern_Goshawk/id#.

Norton, Briony A., et al. “Urban Biodiversity and Landscape Ecology: Patterns, Processes and Planning.” Springer Links, 21 Nov. 2016, link.springer.com/article/10.1007/s40823-016-0018-5#Sec10.

Ocean Plastics Pollution, www.biologicaldiversity.org/campaigns/ocean_plastics/.

Personal communication with Robert DeGroot, a retired Professional Environmental Engineer and Geologist

Personal communication with Karen Schik, the Senior Ecologist for the Friends of the Mississippi River

Personal communication with Bruce Carlson, the Program Supervisor of the Minnesota Biological Survey

Pimm, Stuart L.. "Conservation". Encyclopedia Britannica, 9 Sep. 2020, <https://www.britannica.com/science/conservation-ecology>. Accessed 23 July 2021.

“Planetary Boundaries.” Planetary Boundaries - Stockholm Resilience Centre, www.stockholmresilience.org/research/planetary-boundaries.html.

“Pollinator Biodiversity.” NSF, 5 July 2018, www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=295868&org=.

“The Problem of Urban Sprawl.” Saving Earth: Encyclopædia Britannica, Encyclopædia Britannica, Inc., www.britannica.com/explore/savingearth/urban-sprawl.

Rafferty, John P.. "Urban sprawl". Encyclopedia Britannica, 28 Oct. 2020, <https://www.britannica.com/topic/urban-sprawl>. Accessed 23 July 2021.

“Reduce Salt Pollution.” Friends of the Mississippi River, 14 Jan. 2021, fmr.org/legislative-updates/reduce-salt-pollution.

“Reduce Urban Heat Island Effect.” EPA, Environmental Protection Agency, www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect.

“Residential Beekeeping.” Falcon Height: The City That Soars, www.falconheights.org/residents/residential-beekeeping.

Resnick, Brian. “The Species the World Lost This Decade.” Vox, 9 Dec. 2019, www.vox.com/energy-and-environment/2019/12/9/20993619/biodiversity-crisis-extinction.

“Stencil Storm Drains and More with FMR.” Friends of the Mississippi River, 8 Mar. 2021, www.fmr.org/stenciling.

“Trout Brook Nature Sanctuary.” Capital Region Watershed District, 9 Mar. 2021, www.capitolregionwd.org/projects/trout-brook-nature-sanctuary/.

“Valentine-Clark State Superfund Site Bridal Veil Pond Open Space Operable Unit.” Hennepin County, Minneapolis, 12 Oct. 2007.

Vežner, Tad. “It's the Biggest Park in St. Paul. And Nobody Knows about It.” Twin Cities, Pioneer Press, 24 Oct. 2017, www.twincities.com/2017/10/24/st-paul-biggest-park-nobody-knows-pigs-eye-regional-daytons-bluff/.

“What Are Biosphere Reserves?” UNESCO, 4 Nov. 2020, en.unesco.org/biosphere/about.

“What Is Superfund?” United States Environmental Protection Agency, www.epa.gov/superfund/what-superfund.

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