H.R. 4995 / S. 2705

TRIBAL WILDLIFE CORRIDORS ACT

Image 1.

PRESENTED BY:

TEAM TRIBAL WILDLIFE CORRIDORS ACT

COLUMBIA | SIPA
School of International and Public Affairs

Acknowledgements

We recognize Columbia University and New York City are located on the ancestral lands of the Lenape, Rockaway, and Canarsie people.

...

We thank our advisor, Dr. Robert Cook, for his constant guidance, support, and generosity throughout the duration of this workshop.

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Executive Summary

The Tribal Wildlife Corridors Act of 2021 (H.R. 4995/S. 2705) aims to create wildlife corridors on tribal reservations. The bill was introduced in August 2021 by Representative Rubén Gallego (D-AZ-7) and Senator Ben Ray Luján (D-NM). Currently, it is pending analysis by several Committees in the House of Representatives.

Wildlife species move for many reasons. Organisms may move due to seasonal migration patterns in search of food, water, and reproductive mates, or to escape harsh weather conditions. Climate change also plays an increasingly important role in the movement of wildlife species. Additionally, anthropogenic activities such as urban development, land use changes, and built infrastructure result in habitat fragmentation and degradation, which creates barriers for wildlife migration. Preventing species from moving increases the risk of biodiversity loss. Creating wildlife corridors allows for the connection between fragmented habitats and provides a path for species to move. Many tribal lands are located near protected areas and in migration pathways of wildlife species. Consequently, creating wildlife corridors within tribal lands is an efficient way to promote the connection between wildlife habitats. Tribal nations are already important partners of government agencies in environmental conservation initiatives (z*Legislative Hearing on S. 2891 – Tribal Wildlife Corridors Act of 2019*, 2020).

The history of land ownership and indigenous tribes' self-determination in the United States is complex and has evolved over time. At present, there are approximately 56 million acres of native reservation land across the continental United States. Within tribal reservation lands, land owned by the federal government coexists with privately owned lands held by both native and non-native individuals, creating an intricate checkerboard of land ownership. Additionally, the federal government has historically underfunded Native American tribes (*Tribal Self-Governance Timeline*, n.d.).

In the process of implementing this bill, the Department of the Interior should pay attention to potential problems derived from the establishment of these corridors, such as the potential intrusion of predators, invasive species, disease, or fire through these corridors. However, important environmental programs such as the Yellowstone to Yukon Conservation Initiative already show that wildlife corridors increase the movements and migration patterns of several wildlife species, many of them currently endangered.

This report presents the problems that the Tribal Wildlife Corridors Act of 2021 addresses, the science behind those problems, and their proposed solutions.

Image 2.

Introduction to Proposed Legislation

The Tribal Wildlife Corridors Act of 2021 was introduced in the United States House of Representatives and Senate in August 2021 by Representative Rubén Gallego (D-AZ-7) and Senator Ben Ray Luján (D-NM). It addresses the issues of habitat fragmentation, climate change, and biodiversity loss with a specific focus on tribal reservation lands.

The Tribal Wildlife Corridors Act will authorize the establishment of wildlife corridors on tribal reservation land. Tribes may nominate land within their territories to create a corridor to the Secretary of the Interior, who will then use a set of yet-to-be determined criteria to approve or deny the corridor's establishment within 90 days. Specific criteria for the creation of these corridors will be determined by the Secretary of Interior within 18 months after the bill takes effect. These criteria must focus on three main objectives: restoring historical habitat, managing land to promote connectivity between habitats, and preventing barriers that may negatively impact connectivity.

Once a corridor is approved, the Department of the Interior will provide funding and technical assistance to Native American tribes to construct and maintain the corridors. The bill authorizes up to $50 million to carry out the program each fiscal year, beginning in 2022. This funding will come from the annual budget of the Department of the Interior and must be reauthorized by Congress each year.

A tribe is allowed to choose to remove the Tribal Wildlife Corridor designation at any point. However, in this case, the tribe will not receive any further assistance or funding from the Department of the Interior for that corridor.

In the House of Representatives, the bill was referred to the Subcommittee of Water, Oceans, and Wildlife; the Subcommittee for Indigenous Peoples of the United States; and the Subcommittee on Conservation and Forestry in August of 2021. In the Senate, it was referred to the Committee on Indian Affairs. In both Houses of Congress, it is still under committee review.

Image 3.

Problem I:

Biodiversity Loss through Habitat Fragmentation and Climate Change

Habitat fragmentation and climate change can negatively impact migration and biodiversity. Animals and plants require connected habitats to facilitate migrations, and habitat fragmentation can preclude this movement (Opdam & Wascher, 2004). If climate change makes a habitat unsuitable and habitat fragmentation makes it impossible for a population to migrate to new suitable habitats, the population will not be able to survive. This decreases the biodiversity of an ecosystem and can cause the extinction of populations or entire species.

MIGRATION

is the movement of animals over a distance greater than daily movements, based on seasonal climatic and resource conditions and/or the redistribution of a population. This movement can occur through flying, swimming, drifting, or walking across land, sky, or water (Dingle & Drake, 2007). Migration may occur over extreme distances, such as the Arctic tern, a bird that migrates 80,000 km annually, or shorter distances, such as the elk's seasonal migration to different elevations within Yellowstone National Park (Egevang et. al., 2010).

Plants also migrate, but this occurs on a much slower and more localized scale compared to animal migrations, and it depends primarily on seed dispersal by wind, water, or traveling animals (Pakeman, 2001).

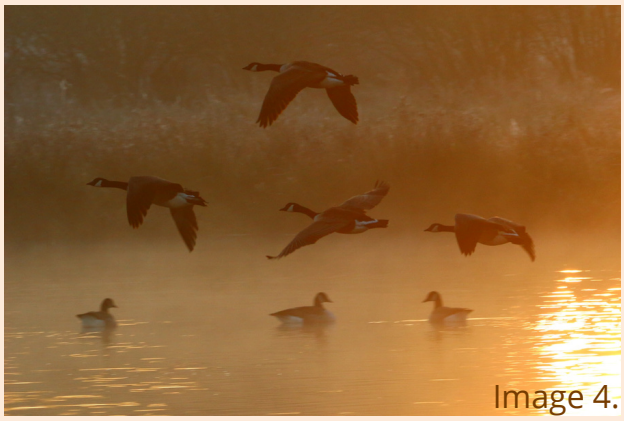

Image 4.

There are many reasons why animals migrate. These include:

Food:

Seasonal changes of food availability is a primary reason for migration. For example, caribou migrate throughout the year in search of suitable food and modify their diet from summer to winter to adapt to shifting availability (*Caribou Species Profile*, n.d.).

Breeding:

Some animals migrate to find mates or appropriate breeding locations. Female sea turtles migrate to specific beaches to lay their eggs, sometimes traveling distances of 2,300 km or more (Luschi et. al., 1998).

Weather:

Many animals migrate to find suitable weather conditions. Elk and mule deer in Glacier National Park descend mountains from higher altitudes to lower altitudes each year to escape harsh winter conditions (Manke, 2019).

Water:

Some species follow seasonal precipitation patterns to access water. For example, dragonflies migrate large distances by following the rainy season in eastern and southern Africa all the way to the monsoon season in India (Pusdekar, 2021).

HABITAT FRAGMENTATION

Habitat degradation occurs when an area becomes less suitable for living beings. While habitat degradation can occur due to natural causes such as fire, it is increasingly attributed to human activities and land use conversion. Human development is encroaching into natural habitats and creating divisions in previously connected ecosystems through the development of roads, communities, industry and agriculture. When a habitat is degraded, it loses its viability as an area of survival for an increasing number of species.

Habitat fragmentation is the division of large habitats into smaller, more isolated habitats, and it is one of the most critical ways that natural landscapes are degraded from anthropogenic activities (Haddad et al., 2015). Not only are these resulting habitats physically smaller, but the reduction in size can also completely alter ecosystem functions such as species richness, pollination, productivity, and carbon and nitrogen retention (Xiao et al., 2016; Haddad et al., 2015).

Overall, the decreasing habitat availability, shrinking habitat size, and increasing isolation of habitat patches caused by habitat fragmentation have a negative impact on migration rates and patterns. Migratory species are unable to safely travel between habitat patches, and migration rates are lower with fewer individuals able to migrate when the fragments are small and isolated (Collingham & Huntley, 2000).

Additionally, an "immigration lag" that leads to decreased species diversity in habitat patches is often observed. One study examined a variety of biomes and species and found that it took longer for species to migrate and establish in smaller and more isolated patches of habitat and this impact increased over time. Due to the lack of immigration into these fragments, there were 5% fewer species in the smaller and more isolated habitats compared to the larger, connected fragments after one year. After a decade, this increased to 15% fewer species in the small and isolated habitats (Haddad et al., 2015). The study concluded that over 35 years, "habitat fragmentation reduces biodiversity by 13% to 75%" and that the rate of loss of species richness was faster in smaller fragments (Haddad et al., 2015).

Continued habitat degradation and fragmentation can also lead to habitat loss, which occurs when an area has lost its full ecological function. Habitat loss refers to the decrease in the spatial extent of natural habitat. These areas are no longer able to support species survival, and organisms must either move to find new habitat or die.

Image 5.

NEGATIVE EDGE EFFECT

Ecological edges are the boundaries of a given habitat, and an abrupt transition between two different habitats along this edge creates a phenomenon known as the "negative edge effect" (Haddad et al., 2015). Habitat edges are higher risk areas than the interior of a habitat, also known as the habitat core, because edge species are exposed to outside influences such as increased predation, disease, and interactions with humans. In addition, habitat edges are subject to different microclimate conditions than habitat cores. For example, habitat edges may experience higher surface temperatures if the tree canopy cover is less dense and provides less shade. These microclimate conditions may be unsuitable for certain species that thrive in the core habitat (Haddad et al., 2015).

As habitats become fragmented, the proportion of habitat that exists along the edges increases, while the proportion of habitat in the core decreases. This results in increased competition for limited space and natural resources within the core, and some species and individuals will be relegated to the habitat edges. Several studies show that increased edge-effect interactions can lead to increased species mortality rates and decreased species densities (Porensky & Young 2013).

CLIMATE CHANGE

Anthropogenic activities, predominantly the burning of fossil fuels, are causing the increase of heat trapping gasses in the atmosphere, which leads to climate change. Higher temperatures, more frequent extreme weather events, and rising sea levels are some of the many consequences of climate change impacting landscapes and the habitats of almost all species on Earth. Migratory species are especially vulnerable to climate change because they often complete different stages of their life cycle in different regions. This means that any impact of climate change on their migration route can severely disrupt their migration and can ultimately lead to the decline in population of migratory species (Kubelka et al., 2021).

Species are sensitive to changes in their environment, especially that of temperature, as many internal and external processes depend on temperature regulation (Seebacher & Post, 2015). Changing temperatures can cause species to alter their migration patterns as many animals migrate based on the seasonal timing of environmental cues (Opdam & Wascher, 2004). For example, higher spring temperatures that occur earlier in the season can shift the traditional timing of migration and breeding. In addition, species' ranges in both hemispheres are shifting away from the equator towards cooler climates, and several species of the temperate zone are shifting their range towards the Arctic (Thomas, 2010).

BIODIVERSITY LOSS

Biodiversity is the variety of life on earth, including genetic, species, and ecosystem diversity (Gaston & Spicer, 2013). Biodiversity has intrinsic, economic, cultural, and scientific value and provides a wide range of services to the natural environment and humans. For example, pollinators provide essential services for crop production, wetlands provide flood mitigation services, and soils provide natural water purification. Biodiversity loss, or the decline of biological diversity, results in a more homogenous world and a decrease in these essential natural services and resources.

Biodiversity loss is another increasing threat to the natural world. Reports indicate that 1 million species currently face threats of extinction (*UN Report*, 2019). The Living Planet Index (LPI), published by the World Wildlife Fund, measures the state of global biological diversity based on population trends of vertebrate species from around the world. The LPI report shows that the major threats to biodiversity are land use, habitat loss and degradation, comprising 52.5% of the total threats to biodiversity (*Living Planet Report 2020*, 2020).

Habitat fragmentation isolates populations and reduces their ability to breed with individuals in other fragments. This reduces the amount of genetic exchange between populations (Gibba, 2001) and, consequently, their overall genetic diversity. In addition, habitat fragmentation and population isolation can lead to inbreeding, which is the mating of related individuals. Inbreeding causes a decrease in genetic diversity, which leads to a greater risk of physical and developmental abnormalities and a weakened immune system (Neaves et al., 2015). These factors in turn can result in greater illness and a higher risk of mortality. For example, the mountain lions of the Santa Monica Mountains of California are increasingly isolated due to human development and have developed inbreeding abnormalities, including undescended testicles in males. This physical abnormality has resulted in lower sperm survival rates and reduced breeding success, leading to population decline (*Puma Profiles*, n.d.).

Figure 1. Threats to Biodiversity in the Living Planet Index

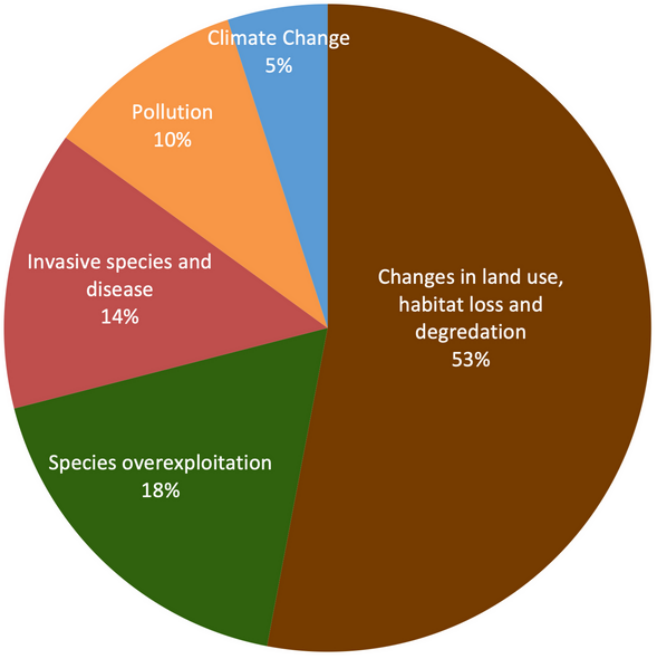

Image 6.

Solution I:
Wildlife Corridors

One way to address habitat fragmentation and the resulting impacts on migration and biodiversity is to create wildlife corridors. Wildlife corridors are areas of land that connect existing habitat patches, allowing organisms to freely move between them. They include highway crossings to facilitate movement over and under roads as well as larger habitat restoration by converting human development and agricultural land into natural landscapes (Hilty, 2019). Corridors reduce the impact of habitat fragmentation because they create pathways for species to move and migrate between patches. This movement assists in the transfer of genetic material between populations, preventing populations from the negative genetic consequences of isolation.

The main principle behind wildlife corridors is habitat connectivity. This refers to the degree to which organisms can travel unimpeded across landscapes, and corridors attempt to facilitate connectivity between habitat patches. Connectivity can either be structural or functional. Structural connectivity considers habitat permeability, which is the potential for animal passage, and measures the physical arrangement of habitat for a multitude of species (Hilty et al., 2020). When species are able to move more freely between habitats, they are able to access resources such as food and water, migrate for appropriate climate conditions, and find mates.

Functional connectivity considers how well genes, gametes, or individuals move through habitat based on known movements (Hilty et al., 2020). Wildlife corridors increase the ability of populations living in different habitats to interact with and mate with one another. They increase the exchange of genetic material and reduce inbreeding. This decreases the potential for physical abnormalities caused by small gene pools and improves reproductive success. Both of these forms of connectivity are crucial in reducing the harmful effects of habitat fragmentation. They demonstrate how wildlife corridors improve the ability of organisms to grow, survive, and reproduce, and they increase the overall biodiversity of a region.

Corridors can assist with connectivity across all habitat types including: terrestrial, marine, freshwater, airspace, and mixed habitats.

- **Terrestrial**: Terrestrial corridors are continuous spaces on land that facilitate daily movement, migration, and gene flow. This includes corridors that connect forest and tundra habitats for caribou migrations.

Image 7:

- **Freshwater**: Freshwater corridors protect the flow of water, sediment, and other natural materials, as well as facilitate the movement of freshwater plants and animals. They can exist in water bodies that flow continuously or intermittently, and they can connect various bodies of water (Hilty et al., 2020).
- **Marine**: Marine corridors connect marine, estuarine, and coastal habitats to facilitate the movement of marine species. This includes fully aquatic species, such as humpback whales that seasonally migrate long distances, to semi-aquatic species, such as sea turtles that require a pathway between the ocean and the shore for adults to lay eggs and for offspring to return to the water. (Hilty et al., 2020).
- **Airspace**: Airspace corridors are a relatively new concept that considers the impact of human development, such as windmills, power lines, and skyscrapers, on the movement and migration of birds and bats (Hilty et al., 2020). These corridors are currently theoretical, but they highlight the need for more innovative and comprehensive habitat protection programs.
- **Mixed**: Mixed corridors refer to corridors that include multiple different types of environments and accommodate various habitats and life cycles of a given species (Hilty et al., 2020). For example, salmon lay their eggs in rivers and streams, where offspring hatch and develop before migrating back to the ocean. A mixed corridor would facilitate connectivity in both the river and the ocean to fully protect this migratory route.

WHERE TO CREATE CORRIDORS

There are a number of factors to consider when deciding where to prioritize the creation of wildlife corridors. These factors can be divided into two categories: 1) type of landscape, and 2) type of species.

Type of Landscape

Wildlife corridors are able to make the most impact on lands of intermediate landscape resilience. Landscape resilience refers to "the capacity of the landscape-wide biota to recover from local species losses in individual patches through immigration at the landscape scale" (Tambosi, 2014). This means that lands with an intermediate amount of intact habitats and connectivity are the best candidates for wildlife corridors. Landscapes that have low landscape resilience are highly degraded and fragmented and are inefficient candidates for corridors because many of the species there are likely already lost. Creating corridors in these locations is not an effective solution, as these species require much more intensive and expensive care than a corridor can provide, and the chances of successful recovery are much lower. On the other hand, areas with high landscape resilience do not need corridors to maintain high levels of biodiversity because they have sufficient connectivity.

Wildlife corridors should also be created in locations where they can connect to existing protected areas. Protected areas in the United States are mostly undeveloped lands that generally have more intact habitat and higher biodiversity rates than other areas of land (Cordell, 2013). However, these protected areas are isolated from one another, which decreases their ability to fully protect species ranges and migratory patterns. Wildlife corridors that connect protected areas increase the ability of these areas to truly protect biodiversity by facilitating the movement of organisms across larger regions.

In addition, connecting wildlife corridors to protected areas improves the effectiveness of the corridors themselves. It is more useful to create a corridor that connects species to high quality habitats than to degraded habitats. Restoring habitats of intermediate landscape resilience and connecting these to areas of higher landscape resilience will increase the overall resiliency of the landscape, and the biodiversity of the entire region will improve.

Figure 2 shows the relationship between protected lands in the United States and Native American reservations. The map displays GAP Status 1 and GAP Status 2 land. GAP Status 1 and 2 lands are United States government designations that refer to lands that are protected to manage biodiversity

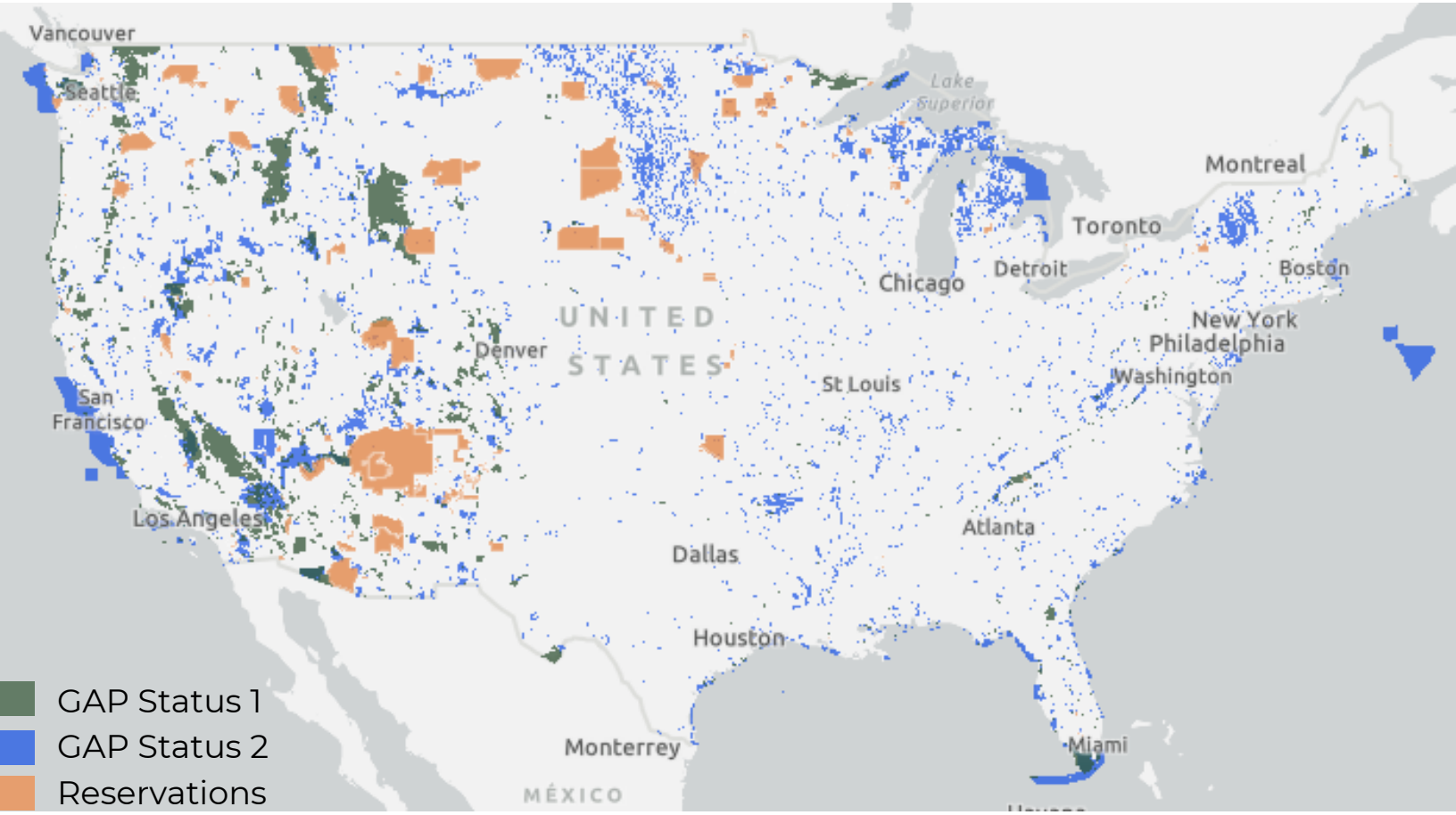

Figure 2. Protected areas in the United States overlapping Native American reservation lands.

that do not allow land conversion and resource extraction. In GAP Status 1 lands, natural disturbances, such as wildfires, are allowed to occur, while in GAP Status 2 land, these disturbances may be repressed. GAP Status 1 lands are more highly protected. It is clear that the locations of Native American reservations are highly correlated with the locations of these protected areas, as both are centered in the American west and in North and South Dakota. Reservation lands would be strategic locations to establish corridors because the corridors could create connectivity between these protected lands.

Type of species to protect

Corridors should be constructed in areas that act as habitat and migration pathways for key species. We define key species for protection as endemic, migratory, and/or umbrella species.

Endemic species, or those that are only found in a specific region, are also important for conservation efforts. Endemic species are at a higher risk of extinction from habitat degradation than non-endemic species because they do not exist elsewhere. The number of species extinctions in an area is much more strongly correlated with the number of endemic species that exist in that area than the number of total species, making the number of endemic species a key indicator for predicting future extinctions (Endemic species, n.d.).

Migratory species benefit from wildlife corridors because they have large ranges and require access to different regions and biomes during different seasons or life stages. Corridors facilitate this movement and improve their ability to safely access necessary resources at the necessary time.

Finally, umbrella species are those that many other co-occurring species within a geographic range depend on (Roberge & Angelstam, 2004). Protection of an umbrella

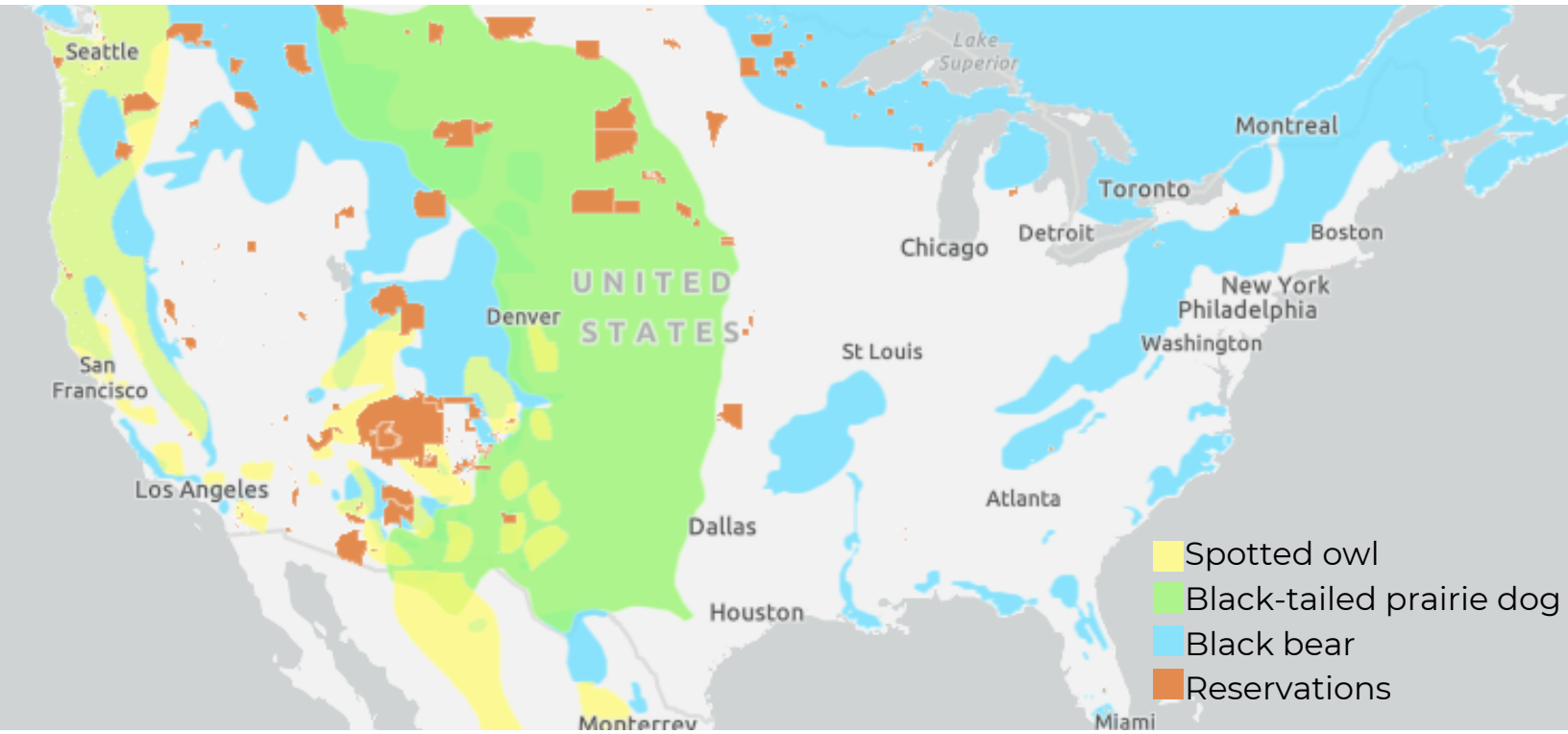

Figure 3. Protected areas in the United States overlapping Native American reservation lands.

species allows for the protection of many other species as well as the preservation of ecosystem dynamics between organisms.

Figure 3 shows the ranges of the black bear, the black-tailed prairie dog, and the spotted owl and their proximity to Native American reservations. These three species are migratory, endemic, and umbrella species, making them valuable species to protection. In addition, their ranges cross tribal, state, and national boundaries, which means that they require the coordination of each of these stakeholders for effective conservation. Native American reservations make up an important percentage of these species' ranges, so establishing wildlife corridors on these lands would assist in fully protecting their ranges and migratory pathways.

Case Study: Yellowstone to Yukon Initiative

The Yellowstone to Yukon (Y2Y) Conservation Initiative is an international organization that manages a 2,000 mile long wildlife corridor between Yellowstone National Park in the United States and the Yukon region of Canada. The Y2Y Initiative collaborates with over 400 organizations to protect biodiversity, restore degraded landscapes, and divert development away from biologically important areas (*Yellowstone to Yukon Conservation Initiative*, n.d.). Y2Y focuses on both the overall restoration of connectivity and migration routes in the region, as well as implements smaller and more localized corridors in important areas. The land throughout the wildlife corridor is owned by multiple stakeholders; 80% is public land and 20% is private or tribal reservation land, spanning 75 different indigenous groups. This wildlife corridor is home to many species such as pronghorn, wolves, bison, and grizzly bears (*Yellowstone to Yukon Conservation Initiative*, n.d.).

The Y2Y Initiative demonstrates the positive impact that a wildlife corridor can have on migration and biodiversity. For example, the Trans-Canada Highway runs through Banff National Park and hinders the movement and migration of black bears and grizzly bears. To address this issue, Y2Y created 23 road crossings over and under the highway. Studies have found that, between 2006 and 2007, black bears utilized these corridors to cross the highway 178 times, and grizzly bears crossed 211 times. Researchers found that peak corridor use was in June and July, hypothesizing that this is due to the seasonal foraging movements of the bears and the need to cross highways more frequently to find food sources (Clevenger et al., 2009).

In addition, they found that the corridors provide genetic connectivity for both species and reduce genetic isolation (Sawaya et al., 2014). 47% of black bears and 27% of grizzly bears that used corridors successfully bred, indicating that the corridor was successful in facilitating the movement and breeding ability of bears (Sawaya et al., 2014).

Finally, the restoration of overall migratory routes in the Yellowstone to Yukon Initiative played a role in the expansion of grizzly bear range. Grizzly bear range increased over 100% between 1990 and 2014 in the areas around Yellowstone in the United States (Hebblewhite et al., 2021), and the population of grizzlies in the entire Yellowstone to Yukon area increased from 400 to 1,700 during this time period as well (Hebblewhite et al., 2021).

Image 8.

Problem II:

Land Management Issues on Indigenous Reservations

Image 9.

There is a long and difficult history between the United States government and indigenous tribes who are the original inhabitants of this land. Early interactions between the United States government and Native Americans were marked by forced assimilation and the dispossession of land and natural resources, forever altering the way that indigenous tribes engage with the land and history (National Congress of American Indians, 2020).

As the United States increased in population and land area during the 19th century, there was a push to expand westward into Native American tribe land. In 1851, Congress passed the Indian Appropriations Act, creating the reservation system that forced tribes to move from their native lands onto federally owned land set aside specifically for tribes (*Timeline*, n.d.). Tribes were relocated, often violently, from their ancestral homelands to areas of the country that they held no connection to. These lands were often the least economically productive and contained limited natural resources.

Following the formation of the reservation system was the Dawes Act of 1887, also known as the General Allotment Act. The Dawes Act allowed the federal government to divide up tribal reservation lands into individual parcels of land. The government owned these parcels in trust and allotted them to individual tribal members as the beneficiaries. This meant that the government owned the legal title to the parcels and had varying degrees of control over the land, such as the power to sell the parcel. After the owner of the parcel passed away, the land was inherited equally by all of their children, creating parcels of land that, in some instances, were owned by hundreds of different people after only a few generations (*Dawes Act (1887)*, 2021).

Under the Dawes Act, the trust period ended after 25 years, at which time the owner would earn the fee simple title and be the true landowner. However, this made Native Americans responsible for paying land taxes that many could not pay. Other Native Americans did not know they ever owned the land, as they were unfamiliar with the legal system. In these cases, many Native Americans had no choice but to sell their land or risk having it seized after a failure to pay taxes. Many of these plots were then sold off by the individual tribe member or by the federal government to private, non-tribal individuals. Between 1887 and 1934, Native American tribes lost 150 million acres of land due to this division and selling of land plots (Farrell et al., 2021).

In 1934, the federal government enacted the

Indian Reorganization Act as the beginning of a new era government policy focused on Native American self-determination. This Act ended the allotment program established by the Dawes Act, extended all trusts indefinitely rather than ending after 25 years, gave any remaining unallotted land to the tribes in the form of trusts, and provided funding for tribes to purchase lost land (*History*, n.d.). In the 1960's and 1970's, important legislation was passed recognizing tribes' self-determination principles, such as the Indian Civil Rights Act of 1968 and the Indian Self-Determination and Education Assistance Act of 1975. This policy of self-governance and self-sovereignty has guided United States and Native American relations for the past century as the US government has provided more opportunities for indigenous tribes to make their own land use decisions.

However, this earlier buying and selling of reservation land has created a checkerboard-like effect in which individual parcels of land across a reservation may be owned by the federal government, individual tribal members, or non-tribal members. These different forms of land tenure subject the landowners to different federal regulations and different levels of control. This can make large-scale land use decisions such as wildlife corridors exceptionally difficult as many different stakeholders with complicated and competing interests must agree.

In addition, the US federal government has historically underfunded programs dedicated to tribal nations. Treaties signed up until 1871 between tribal nations and the federal government created the federal Indian trust responsibility, in which the US government agreed to fund various critical services for tribal nations in exchange for land and natural resources (National Congress of American Indians, 2017). Today, tribal nations rely on these funds to maintain their own government as well as to create and develop infrastructure, health care, education, police departments, and housing (National Congress of American Indians, 2017). However, because of the inter-governmental limitations, tribal nations are unable to levy taxes, prohibiting them from raising substantial amounts of funding needed for services and programs (National Congress of American Indians, 2017).

Tribal nations may seek federal or state government issued grants for additional funding, but these are only available to the 574 federally recognized tribes (*Federally Recognized Indian Tribes and Resources for Native Americans*, n.d.). This prohibits more than 200 tribes that are not recognized by the federal government from receiving these benefits.

With federal or state government issued grants and programs for tribal nations, technical assistance is a common provision to coordinate funding disbursements and grant activities. However, historically, technical assistance to tribal nations is disjointed and uncoordinated leading to confusion on how to access services (*Tribal Access Workgroup Report*, n.d.). This is often due to a strained relationship between the entities involved and to underfunded, undeveloped programs.

Finally, it is important to recognize that many indigenous tribes have a deep cultural connection with migratory species. Hunting has historically provided indigenous tribes with not only food and other animal products, but also a cultural identity through generations of tracking migratory species (O'Flaherty et al., 2008; Lee 2018). The loss of habitat and biodiversity threatens the ability of Native American tribes to practice their cultural and spiritual traditions. This threat is

Image 10.

exacerbated by the fact that modern-day tribal lands are much more vulnerable to climate change than historical tribal lands. They experience two additional extreme heat days per year and receive 23% less precipitation per year relative to historical lands (Farrell et al., 2021). Modern-day lands are also 19% less likely to contain valuable oil and gas resources (Farrell et al., 2021).

> **"The loss of habitat and biodiversity threatens the ability of Native American tribes to practice their cultural and spiritual traditions."**

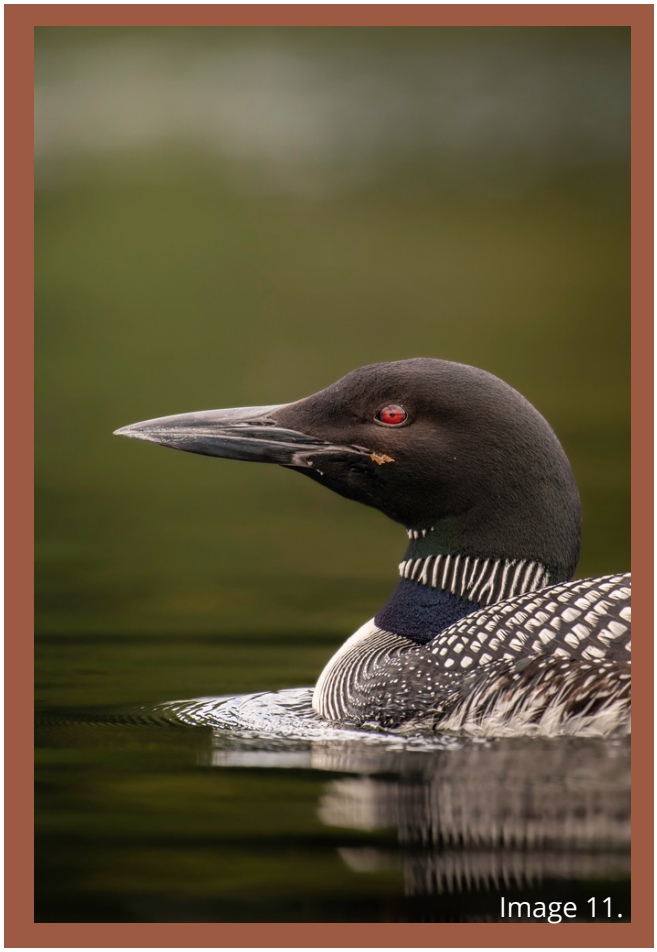

Image 11.

Image 12.

Solution II:

Funding & Technical Assistance

Funding

Tribal nations lack the ability to levy taxes to support critical programs and require federal funding as part of the US's long standing trust obligation. Additionally, if state and federal funding is not dedicated specifically to tribal nations, indigenous tribes must fight for funding with other agencies and organizations, which they often lose out on (*A Quiet Crisis*, 2003). The Tribal Wildlife Corridors Act provides grant funding specifically for tribal nations to create and designate wildlife corridors on tribal land.

Each federal agency or department is granted a mandatory budget and a discretionary budget. Mandatory budgets are required by law and are always available for the set program (*A Quiet Crisis*, 2003). Discretionary budgets are determined by an appropriations act and can be an exact amount or can vary based on a variable or time frame (*A Quiet Crisis*, 2003). Funding from the federal government is allocated to tribal nations as part of the discretionary federal budget (National Congress of American Indians, 2017). The Act requires the Secretary of the Interior to select and allocate grants to one or more Indian Tribes. The grants will pull from a discretionary appropriation of up to $50,000,000 annually.

Technical Assistance

The Tribal Wildlife Corridors Act requires the federal government to provide technical assistance for the establishment of tribal wildlife corridors. Technical assistance can be defined as services and programs provided by federal and state agencies, as well as third party organizations, to the grantees to improve established goals and outputs (*Grants Management*, 2020). Government technical assistance programs vary depending on the grant provisions and the specific outcomes that the program is attempting to achieve (*Grants Management*, 2020). Technical assistance can include services such as operational assistance, managerial development, program support, education and training, and asset management (*Tribal Access Workgroup Report*, n.d.).

In the bill, technical assistance will be centered around the creation and management of corridors. The provisions of the technical assistance as defined in the bill are "assistance with accessing wildlife data and working with voluntary private landowners to access Federal and State programs to improve wildlife habitat and connectivity on non-Federal land" (*Tribal Wildlife Corridors Act of 2021*, 2021). It also strengthens the coordination between landowners, tribes, and government agencies.

Government provided technical assistance requires alignment between funding recipients and technical assistance agencies (*Tribal Access Workgroup Report*, n.d.). In a study conducted by the University of North Carolina at Chapel Hill on the Indian Health Service (IHS), it was determined that technical assistance is most effective when it is flexible and tailored specifically to the program and when trust is established with tribal communities (Letourneau, 2007). Due to historical inadequacies in services and funding from the federal government, many tribal nations are hesitant to accept help. Fostering trustworthy relationships between tribal nations and providing agencies is crucial (Letourneau, 2007).

Image 13. Flags of the United States and the Navajo Nation

Case Study: Santa Ana Pueblo

The Santa Ana Pueblo community has successfully restored significant portions of their reservation land, known as the Tamaya Indian Reservation located in New Mexico. The tribe established a Department of Natural Resources to manage their land and restoration projects, collaborating with many US federal agencies such as the Environmental Protection Agency, the Fish and Wildlife Service, and the Army Corps of Engineers (Department of Natural Resources: Range and Wildlife Division, n.d.). Through their efforts, the Santa Ana Pueblo tribe has been able to protect many different wildlife species, as well as reintroduce the pronghorn and the wild turkey, two species with important cultural significance (Santa Ana Pueblo, n.d.).

However, the tribe recognizes that there is still more work to be done. They recently purchased 66,000 acres of former range land to dedicate to wildlife restoration projects (Paskus, 2017). Their goal is to collaborate with nearby national forests to facilitate connectivity between the forests and the reservation land to protect migratory species, such as elk and mountain lion, with larger ranges that require more land than the tribe can currently provide.

When asked what he would do if given one million dollars, Glenn Harper, the Range and Wildlife Division Manager of the Department of Natural Resources, described further projects to bring back the pronghorn and wild turkeys and to protect migratory mule deer. He wants to create wildlife corridors over a large interstate highway that would be crucial in protecting mule deer and their migration patterns (Hill, 2021). The Tribal Wildlife Corridors Act can assist in these efforts by providing the necessary funding and establishing a formal relationship to advance conservation programs between the tribe and the US Department of the Interior. In addition, the bill would provide essential technical assistance to support the tribes in monitoring the success of their corridors and tracking species' movements.

Challenges & Controversies

While wildlife corridors have been successful at facilitating connectivity between habitat patches, they may have negative impacts on surrounding habitats. These controversies were evaluated through a review of existing studies, though it is important to note that these studies are limited in number and scope, and that while many of these negative effects have been found in controlled experimental settings, they have not been seen in implemented wildlife corridors. Nevertheless, they are important factors to consider while designing and implementing a wildlife corridor.

NEGATIVE EDGE EFFECTS

Wildlife corridors tend to be narrower than the habitat patches that they connect, and thus a greater proportion of the habitat will be edge. Corridors may experience greater negative edge effects, and some species may not use the corridors to avoid these edge effects, making the corridors less successful (Hilty et al., 2019). However, it is important to note that while corridors themselves may be more adverse habitats, they counteract negative edge effects of the connected habitat patches. Corridor designers should create corridors that are as wide as possible in order to decrease the impact of the negative edge effect and improve corridor success (Haddad et al., 2014; Beier et al., 2008).

PREDATORS

Corridors can increase the rate of predation as a result of increased negative edge effects in the corridor and the facilitation of predator movement between habitat patches. Research on the relationship between avian nest predation rates and edge effects, has found that predation can increase along habitat edges (Marini et al., 1995; Ruffell et al., 2014; Spanhove et al., 2009). This is due to increased amounts of prey in edge habitats, exposure of prey to a greater variety of predators from both inside and outside of the habitat, and increased travel of predators along edges (Hilty et al., 2019). However, other studies have found that predation rates on edges of wildlife corridors are not impacted at

all or have higher rates of predation in the corridor core (Spanhove et al., 2009). Findings on the impact of negative edge effects on predation are context-specific and can not necessarily be scaled outside of these experiments.

Corridors also can, in theory, increase predation within habitat patches if predators found in one habitat patch move through the corridor to a habitat patch that they were not previously present in (Hilty et al., 1995). However, corridors typically act to restore habitats, and predators that move between corridors are likely being reintroduced into ecosystems that they once inhabited. The movement of predators through corridors would only be an issue of concern if an endangered species is negatively impacted by the reintroduction of predators. This should be a consideration of any corridor project in order to reduce this risk.

INVASIVE SPECIES

Through a review of existing and experimental corridors, there is not ample evidence that corridors increase the spread of invasive species. However, one experimental study done by the University of Florida found that invasive polygyne fire ants, or ants that have multiple queens in each colony, spread widely through patches connected by wildlife corridors, while monogyne fire ants, or ants that have only one queen per colony, did not. The increased number of polygyne fire ants decreased the number of native ant species in the same patches connected via corridors, implying that the invasive ants negatively affected the native ants. However, as this was an experimental habitat, the researchers noted that this may not be scalable or permanent (Resasco et al., 2014). In addition, similar to predators, it is possible that the corridors themselves may be host to more invasive species. Corridors tend to have more edge than habitat patches, providing more area for invasive species to potentially enter and increasing interactions between habitat and non-habitat species (Hilty et al., 1995).

DISEASE

Another potential concern about wildlife corridors is that disease-causing organisms, or pathogens, could move from one habitat to another that previously did not contain them. This concern has been studied in controlled experiments, but it has not been evaluated in actual corridor environments. One such study evaluated the effect of increased connectivity via corridors on the the spread of plant parasites, as well as evaluated how the edge effect may impact disease (*Biotic/Abiotic*, n.d.). The study found that habitat edges edge can affect the development and spread of pathogens because of their altered climate (Sullivan et al., 2011). In addition, edge habitats have more interactions with exotic species and humans, which can increase the opportunity for novel pathogens to enter a habitat. These conditions have only been observed in an experimental setting, and researchers note that the spread of pathogens should be considered when designing a corridor (Sullivan et al., 2011).

FIRE

There are no documented instances of fire spread being facilitated by wildlife corridors; however, there is evidence that corridors can increase the temperature of fire. Evidence was collected during prescribed fires in the

world's largest corridor experiment at the Savannah River Site in South Carolina (Brudvig et al., 2012). This experiment found no impact on the pattern of wildfire spread throughout the fragmented and corridor landscapes. However, it did find that fires in and around corridors burned hotter than areas without corridors, and hypothesized that this was due to indirect edge effects. There is an increased edge along the corridor, and this edge contains more leaf litter, making the fire hotter (Brudvig et al., 2012). This is an important consideration for the construction of corridors in areas prone to wildfires, such as the American west where the majority of tribal reservation land is located.

Image 14.

These threats are serious concerns that should be considered in any wildlife corridor project. However, research on the topic is limited, and it is unclear what results from controlled experimental settings can be replicated in actual wildlife corridors. Much more research needs to be done on these topics in order to effectively manage corridors to mitigate their potential negative impacts.

"Much more research needs to be done on these topics in order to effectively manage corridors to mitigate their potential negative impacts."

Measures of Success

It is critical to be able to measure the success of the Tribal Wildlife Corridors Act. There are three main outcomes that the bill aims to achieve: safer and increased migration of species; a greater number of wildlife corridors on tribal lands; and increased tribal environmental stewardship. These outcomes can be measured using a number of ecological and social indicators. There are readily available and widely utilized ecological indicators that can be used to measure the success of the bill. However, measurements of social indicators of success are more difficult to measure and still need to be defined.

Image 15.

Ecological Indicators

1

Number of species utilizing corridors

One way to measure the success of a wildlife corridor is to determine the total number of different species that utilize the corridors. This can be measured through the use of track pads and camera traps. Track pads are typically metal plates that are covered in a thick layer of dirt and placed on the ground in a corridor. Experts regularly monitor the pads and identify the tracks of different species that have walked over the pads. Trap cameras are motion-activated cameras that take photographs of animals that walk in front of them, and researchers are able to review the images to determine the different species that have been photographed (Clevenger et al., 2009). Track pads and trap cameras are best for mammals. Using these two methods, researchers can identify the different species that use corridors, which can help to establish which species in a given habitat benefit from the creation of corridors.

2

Number of individuals of umbrella species utilizing corridors

An umbrella species is a species that, when protected, lends itself to the protection of other species. Since it is difficult to track individuals of every species, tracking individuals of an umbrella species can determine the effectiveness of a corridor. If many individuals of an umbrella species are using a corridor, it is likely that other species are too (Roberge & Angelstam, 2004).

Scientists can measure the number of individual organisms of an umbrella species that utilize a corridor through hair traps, which collect animal hair as individuals pass through. DNA obtained from hair allows researchers to measure different individuals of the same species using the corridor (Clevenger et al., 2009). These methods can also tell researchers about temporal and seasonal variation in corridor use. Some species may use a corridor with greater frequency during specific times of the year based on migratory patterns.

3

Gene flow of populations utilizing corridors

Another indicator of corridor success is the gene flow of populations that utilize corridors. Gene flow is the transfer of alleles, or variants of any given gene, between populations due to mating (Mitton et al., 2013). Increased gene flow signals increased corridor usage because individuals are using the corridors to connect with less related populations (Sawaya et al., 2014). DNA collected from hair traps can also be used to analyze the transfer of genetic information across populations.

4

Range expansion of species

Range expansion is another indicator for corridor success. Researchers can observe the degree to which the range of a species or a population increases to determine if the given species is utilizing the corridors to access new habitats.

There are a few key considerations to ensure accurate measurement. First, measuring the success of a wildlife corridor is best done when a baseline is established by collecting species census data before and after the creation of a wildlife corridor. Second, numerous studies indicate that there is a generational lag time regarding corridor utilization. It can take 2-3 generations of a species to learn and teach others how to use the corridor, so it is best practice to monitor corridor usage over long, multi-year periods of time (Gregory & Beier, 2014).

Social Indicators

The most clear social indicator of the success of the bill is the number of tribes that nominate and build wildlife corridors. This would signify that tribes are interested in participating in the grant program and that wildlife corridors are being successfully created. If passed, the grant program of the bill would require reauthorization each fiscal year, and therefore needs to demonstrate the successful expenditure of funds. An increasing number of tribes applying in each grant cycle also indicates the success of the program.

There are also qualitative indicators to measure success of the bill and how corridors influence tribal environmental stewardship. For example, the implementation of the bill may strengthen co-management relationships between tribes and the federal government. Monitoring the level of community engagement with corridor management may also be useful. Social indicators are more qualitative in nature, and should be measured in a more holistic approach (*Social Indicators*, 2015). While these qualitative indicators can be used, the best way to measure them is yet to be determined.

Image 16.

Conclusion

Biodiversity is important for ecosystem function, but it is being lost at increasing rates due to a number of phenomena, including habitat fragmentation and climate change. Organisms migrate for many reasons, including shifting ranges due to changes in temperature patterns from climate change. Additionally, habitat degradation and fragmentation prevent organisms from moving from isolated patches to find more suitable habitats. Wildlife corridors are able to mitigate these multifaceted effects by restoring wildlife habitat in areas degraded by human development, including agriculture and natural resource extraction. In wild areas separated by highways, over and underpasses can allow for movement of some species between these fragments. Connecting already protected areas in the United States has the greatest potential for resilient corridors. Protected areas and Native American reservations are highly correlated, therefore, creating corridors on reservation lands will increase connectivity between important wildlife areas. The success of the Yellowstone to Yukon Initiative on both public, private, and tribal lands demonstrates the importance of wildlife corridors on tribal lands.

Historically, indigenous people in the United States were forced from their homelands and placed on distant reservations. They were subjected to harmful land allocation policies, and have suffered from a lack of government funding and assistance.

Many reservations were divided up between multiple types of landowners including the federal government, individual tribal landowners, and individual non-tribal landowners. The diverging interests of these stakeholders makes it difficult for large scale land-use decisions to pass. The United States government can provide funding, technical assistance, and landowner coordination to counteract the difficulties of land management on tribal reservations.

The Tribal Wildlife Corridors Act of 2021 supports the creation of wildlife corridors within tribal reservations, increasing the connectivity of isolated habitats. Reservation lands are essential for wildlife corridors given their proximity to protected areas and their overlap with ranges of biologically important species. This will be achieved through an annual $50 million program for federal grants and technical assistance to Native American tribes for wildlife corridors on reservation land.

Image 17.

Graphics Acknowledgements

In Order of Appearance

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