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A SPARK THAT STARTS THE FIRE
Climate Change in American West

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PROFESSIONAL PAPER
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Environmental Science and Natural Resource Journalism

A Spark that Starts the Fire:
Climate Change in the American West

Chairperson: Henriette Lowisch

Abstract Content:

Climate change is a large, unwieldy, global phenomenon that acts like a spark in a dry field. A slight rise in the global temperature weakens the Gulf Stream and sends the East Coast into a deep freeze. A slight dip in the global temperature, caused by a volcanic eruption, alters weather patterns and dumps record amounts of rain in Southeast Asia. The three stories in this portfolio depict how climate change can alter the landscape and people of the American West. Chapter one is a narrative summarizing these stories, my reporting process, and publication plans. Chapter two is an embedded link to a radio story about a doctoral student (and new father) grappling with the prospect of climate engineering - a “plan B” for combating climate change. Chapter three is a video script explaining megadroughts, which were decades-long, severe drought that turned Nebraska into a sand-strewn desert. Chapter three is a magazine-style feature on the last, wild caribou in the contiguous United States.

Chapter One

Narrative

Climate change is a large, unwieldy, global phenomenon that acts like a spark. A slight rise in the global temperature weakens the Gulf Stream and sends the East Coast into a deep freeze. A slight dip in the global temperature, caused by a volcanic eruption, alters weather patterns and dumps record amounts of rain in Southeast Asia. Climate change is the drying out of a Syrian desert that kills crops, sparks a violent civil war and leads to the rise of the Islamic State.

That's why it can be so tough to report on climate change. You can see the war and the flooding and the water shortage, but it's so much harder to tease out the roots of those phenomena. And, as a journalist, when you do tease out those roots, you often end up with a boring story filled with numbers and explanations about temperature, carbon dioxide and rising sea levels. Which is why we need to find a balance between hard data and the narrative. It's not enough to list the "teeth" of the story – one needs to show how they affect real people and the world they live in.

Over the past two decades, journalists and media organizations have invested heavily in portraying those affected by climate change. The Guardian has an entire desk devoted to environmental issues – unheard of twenty years ago. Their recurring series, Vital Signs, showcases the connections between humanity and the planet. An ecologist worries over the effects of drought on giant sequoias in California; researchers battle over how climate change exacerbates war, and Pacific Islanders face oblivion from food shortages, floods and droughts triggered by an ocean that's rising around them.

And yet, however far we've traveled as journalists in our coverage of climate change, we still need to hone our skills and give more to the story. In many American news outlets, climate change stories are buried beneath election news, sports, and funny GIFs of cats dancing – the stuff that pulls viewers in and keeps them on the site. How can we tell stories of climate change that keep people in their seats?

One way is using new formats, and publishing on new platforms, to tell the story.

In 2014, I crafted a five-minute, non-narrated radio piece on Wylie Carr, a doctoral candidate and new father studying the ethics of climate engineering. It's a "Plan B" for combating climate change – a series of proposals to artificially cool the planet and temper global warming. Over the past decade, government organizations, private institutions and wealthy individuals, including Bill Gates, have poured millions of dollars into climate engineering research. The idea terrifies Carr. However, by the time his daughter, Lucy, is an adult, there's a chance it could become a reality.

The piece emulates the style of NPR's Snap Judgment and KCRW's UnFictional, two popular podcasts that find compelling stories told by the characters who experienced them. I tried to allow Wylie and his wife, Austen, to explain

the acute fear of bringing a child into a world marred by climate change. Jule Banville was essential in teaching me the basics of radio, and guided me through this story as a student in her Advanced Audio class.

Another new media outlet with the potential to reach new audiences is YouTube. Last March, I wrote a 1,000-word primer on megadroughts for SciShow, YouTube's most popular science education channel. By 2050, NASA predicts the American Southwest could be in the midst of a megadrought – a decades-long dry spell that could turn Phoenix and Los Angeles into dust bowls. Historically, climate events of this scale destroyed aboriginal cultures and dramatically changed landscapes. We see their effects to this day. But what are they? How are they caused, and how do we combat them?

SciShow is similar to The Daily Show – it takes big concepts and breaks them down into easily digestible and entertaining talking head-style shows. Yet the rigorous fact-checking of old-school journalism is still a pillar of SciShow's work. For the mega-droughts piece, I needed to source every fact I used. And these sources couldn't be other news organizations – they needed to be scientific articles, scientific press releases, or government and university websites. I learned script writing while working as an intern at National Public Radio – Morning Edition. However, not even a national news organization like NPR could compete with the number of rigorous edits I received from the staff at SciShow.

While these first two pieces used new media techniques to tell interesting stories about climate change, I also wanted to stretch my narrative muscles and write a magazine-style piece that told a compelling, character-driven story about a population affected, in part, by climate change.

During the 19th century, thousands of woodland caribou ranged across the northern tier of the United States. A century's worth of climate change, predation and deforestation drastically reduced their numbers. There are now only a dozen woodland caribou still living in the Lower 48.

Over two years, I interviewed nearly a dozen sources to craft a narrative about the history of these animals, and the story of the biologists trying to save them. These caribou are the most imperiled game animal in the United States, yet very few national news outlets are covering the story. I will pitch it to The Guardian, High Country News, or a similar outlet.

Climate change is the spark connects all three pieces in my portfolio. It's a mega-drought that turned Nebraska into a sand-strewn desert. A slight rise in temperature that ends the Little Ice Age and leads to wildfires, which help wipe out most of the caribou habitat in the Lower 48. It's the spark which prompts scientists to consider engineering the global climate. It burns in the background, causing the world to change and forcing humanity to change with it. These are the stories I hope to tell as I begin my journey as a journalist.

Chapter Two

It's All About Lucy

Radio

A link to this audio story is embedded [here](#)

Chapter Three

The Great North American Megadrought

[Online Video \(Click to Watch\)](#)

Aired on SciShow May 25, 2015

SCRIPT BY NATE HEGYI

The state of California is currently experiencing one of its worst droughts ever. It's draining the local water supply and turning reservoirs into empty bath tubs.

But there's a worse threat lurking around the corner: a megadrought, a more extreme version of a drought that can last for decades.

Prehistoric megadroughts are said to have toppled ancient civilizations in Cambodia, South America and North America. They've turned entire prairies to sand dunes.

In February, a study from NASA suggested that western North America could enter a megadrought within the next few decades, propelled in part by climate change.

But what are megadroughts, how are they caused, and what can we do about them?

Well, let's talk about plain old regular droughts first.

Basically, a drought is an extended period of lower than average rainfall. It's often called a creeping phenomenon, because unlike other natural hazards like earthquakes and hurricanes, droughts come on slow.

They can take anywhere from a week to a season to develop, deepening in severity with every passing day and leading to crop failure and water shortages. Normally, they last for up to a few years.

Then there are megadroughts, which can last for a few / decades/.

The term was first popularized in 1998 by two American environmental scientists named Jonathan Overpeck and Connie Woodhouse, in a paper they wrote reconstructing the climate history of the American Great Plains.

They wanted to put the terrible droughts of the 20th century, like the Dust Bowl of the 1930s, into context.

See, prior to this study, there were all these smaller, regional studies that suggested there was a really bad drought in the Great Plains between 900 and 1400 CE, also known as the medieval period.

For instance, historians in the early 1930s suggested that

a Great Drought swept through the southwestern United States and coincided with the abandonment of ancient Anasazi villages and the redistribution and reorganization of populations across the West.

And in 1974, a study of the number of bison bones found in archaeological dig sites across the southern Great Plains found that there were far fewer bones dating back to this period compared to the eras before and after.

Then, in the early 1990s, a geographer carbon dated dead tree stumps that were found at the bottoms of lakes and river beds in the Sierra Nevada mountains in California. He discovered that most of them were alive during the medieval period.

The trees couldn't have grown underwater, so he theorized that the climate must have been so dry that these lakes and rivers used to be much smaller.

But these studies were all like individual puzzle pieces in a much larger picture of the Great Plains during this medieval dry spell.

So in the late 1990s, Overpeck and Woodhouse reconstructed the /entire/ Great Plains' historic climate, going back to 1 CE.

To do that, they used paleoclimate data: data derived from ice cores, tree rings, coal, soil sediments... anything natural that's been around for a really long time.

Take trees, for instance. In temperate areas, like much of North America, Asia and Europe, trees only grow during part of the year -- the growing season.

Near the beginning of the growing season, the tree grows faster, expanding and forming paler wood. But toward the end, the tree grows slowly, forming more condensed and darker wood.

This process repeats itself every year, and the contrast between the light and dark wood forms growth rings, which is why counting a tree's rings can help you figure out how old it is.

In good growing seasons -- ones with favorable temperatures and more precipitation -- the trees grow faster and form wider growth rings. But in poor growing seasons -- ones with extreme temperatures and less precipitation, like during a drought -- the trees form thinner growth rings.

But there are issues with tree ring chronologies, as they're called. For instance, trees only grow in the warmer months, so the rings can't show us what the climate was like in the winter.

And stressors can affect tree growth, like competition with other plants or poor soil nutrients.

That's why Overpeck and Woodhouse used many different types of paleoclimatic data, /including/ tree rings, to figure out what happened in the Great Plains.

They discovered a series of major, severe droughts. We're talking worse than the Dust Bowl.

The scientists called these great droughts.... megadroughts, and the term stuck.

Subsequent studies showed that some of these megadroughts lasted for more than forty years, and they could be incredibly persistent in their severity. Between 1140 and 1165, for example, droughts as dry as the Dust Bowl would happen year after year after year.

And from 1276 to 1313, sediment studies have shown that the state of Nebraska -- which is now covered in prairie grass -- was full of massive sand dunes.

It wasn't all bad every year during these periods. Occasionally, a year or two were actually wetter than average, but the norm... was drought.

That changed the environment dramatically, which is why studies kept finding things like absent bison bones, sand dunes, abandoned villages and tree stumps beneath rivers.

But megadroughts aren't unique to the medieval Great Plains.

A 2009 study published in Science Magazine suggested that Sub-Saharan Africa has suffered from megadroughts in the past, including one as recently as 300 years ago.

And Southeast Asia experienced megadroughts in the 14th and 15th centuries, interspersed with heavy monsoon seasons. But how do these megadroughts happen?

Well, again, first you've gotta understand how regular droughts happen.

There are three main contributors to a drought -- soil moisture, atmospheric circulation patterns, and land and sea surface temperatures.

Soil moisture is the amount of water in the soil. When the ground is wet, that water evaporates as the day heats up.

It rises, eventually interacting with cold air high above in the earth's atmosphere. That cold air causes the moisture to condense back into a liquid and that's how you get rain.

But those rain clouds don't always stick around. They can be carried hundreds of miles away from the source by atmospheric circulation patterns, which are giant, worldwide air currents powered by heat and evaporation from the ocean.

Earth is basically a huge, complex water recycling machine. But things can go wrong.

Sometimes, these circulation patterns shift due to the cooling or warming of surface ocean temperatures, and rain might stop arriving in a region as frequently.

When this happens, the soil moisture drops. Each day, more moisture is evaporated into the air without being returned to the surface. The hotter it is on the ground, the faster it evaporates.

Eventually, it turns into a drought.

But when these temporary shifts in atmospheric circulation patterns become the /prevailing/ patterns, you end up with a megadrought.

Take those medieval Great Plains droughts, for instance. Scientists aren't entirely sure why they happened, but they do know that the surface of the tropical Pacific cooled, altering the path of atmospheric circulation patterns over North America for centuries.

And now, NASA researchers are suggesting that a megadrought might be returning to the North American West. and this time they know what would be causing it: climate change.

California's current drought problem it's a big deal -- the deepest the area has dealt with in 1,200 years, according to a recent study. But that drought began only three years ago, in 2012. It's still a regular drought, though a prolonged one.

The team wanted to see what was in store for both California and the rest of the North American West on a much larger scale... over the course of the next /century/.

So they used a complex set of metrics, including soil moisture data, as well as current and projected greenhouse gas emissions, to model the future climate.

They came up with two forecasts.

The first showed how drought developed if greenhouse gas emissions continue as they are now, while the second looked at what happened if those emissions were much lower.

In both cases, megadroughts were predicted for the later half of this century. But unlike those previous megadroughts in the American West, which were caused by a decrease in rainfall, these new megadroughts would have a different trigger: an increase in evaporation due to warmer temperatures.

Essentially, the region -- which already receives less than 250 millimeters of rain a year -- is going to get hotter, which will dry out the land more quickly.

This starts a vicious cycle. When the rains do come, mostly between April and September, they can't replenish the amount of moisture that was lost, deepening the drought each year.

With current greenhouse gas emissions, the forecasts say that there's an 80 percent chance that these megadroughts will happen -- and they'll be more severe and prolonged than the medieval megadroughts. Soil moisture will be twice as low as it was back then.

But, if greenhouse gas emissions stop increasing by the mid 21st century, the chance of a megadrought decreases to 60 percent -- and if it does happen, it won't be as bad.

Either way, a future megadrought in the North American West would be... challenging.

For the past 150 years or so, human populations in the area have needed more and more water. A megadrought could lead to widespread crop failure, as well as the further depletion of nonrenewable groundwater resources and reservoirs.

But it's still early in the game. There are ways to mitigate these risks, like alternative methods of farming that don't use as much irrigation, or by reusing water.

Mostly, it would also help if we could figure out how to live on less water, and one way to do that is by reusing greywater: wastewater from clean-ish activities like showering or laundering clothes. It makes up about 60 percent of all the water used in a household.

Nowadays, greywater is often mixed with black water, which is highly contaminated water that comes from toilets, when it's washed down the drain.

But if you separate that greywater, it can be recaptured and used to water gardens and fill toilet bowls -- basically anything that doesn't involve eating or drinking it.

Reusing greywater could reduce a household's daily water needs by up to 40 percent.

Then there are more extreme measures, like desalination plants.

In a desalination plant, you pump seawater at high pressure through screens that filter out the salt. One proposed in Carlsbad, California could provide the state with 50 million gallons of fresh water a day! But there are drawbacks.

Modern desalination plants are expensive to build -- the Carlsbad project would cost a /billion/ dollars -- and they can leave a hefty environmental footprint.

The plants use, on average, 15,000 kilowatts of power to filter one million gallons of seawater. By comparison, it takes only 3400 kilowatts to pull one million gallons of water from an aquifer or reservoir.

So even though a desalination plant could provide clean water to a drought-stricken region, it would also make the environmental problems worse.

One way to compensate is by funding efforts to /fix/ the environment -- like buying carbon credits or helping restore wetlands. But still, that's not exactly ideal.

So climate scientists and environmental engineers have their work cut out for them, but hopefully by the time a megadrought hits, we'll be ready.

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Chapter Four

Wake of the Caribou: Why efforts to rescue an endangered species in the lower 48 are failing

Narrative, magazine-style feature

The blood had dried by the time Bart George pulled his Ford pickup over on a high mountain pass in southern British Columbia. It was late fall in 2015 and the air was crisp. George always kept his passport in the truck -- he never knew when he'd need to rush across the border between the U.S. and Canada to investigate a kill. Now was one of those times.

Three other men mingled on the side of the road. One carried a large-caliber rifle. Together they descended the mountain and entered a creek bed. The sun was bright and they were surrounded by chest-high, yellow brush. George's adrenaline was pumping.

"We start finding blood and fur," he said.

Disturbed earth, matted grass. As the men crept forward, they saw a dark hump moving in the brush.

Black bear.

George's heart walloped; after a moment, he picked up a stick and threw it at the animal. The other men hollered, and the bear skittered away from the meal it was scavenging on: a dead woodland caribou.

Woodland caribou are different from their northerly, arctic-dwelling cousins. They're larger, darker, and don't really migrate.

This particular woodland caribou was torn apart, its eyes glazed white with death.

"You treat it like a crime scene," George said. He's a biologist with the Wildlife and Territorial Resources Division of the Kalispel Tribe of Indians, based in Usk, Washington.

The other three men were a Kootenai tribal biologist, a British Columbia provincial biologist and a professional wolf trapper. They had received a mortality signal the previous evening from the collar the caribou was wearing, and now they were performing a field necropsy - taking photos and investigating the body.

The animal was a mature bull -- the biggest in the herd -- and its head had been pulled mostly away from the body and eaten.

"The collar is laying there in the mess," George said. "There wasn't much left."

George peeled back the bull's skin and saw bruising on its front shoulder. It was lying less than a quarter-mile from the highway, suggesting that it may have been struck by a vehicle. Wolf tracks, bear tracks and scat surrounded the body. They scavenged the caribou, and may have even finished it off, George wagered.

He carried the animal -- or what was left of it -- out of the field in a backpack and returned to Usk.

The dead bull was number thirteen.

There are now only twelve woodland caribou left in the contiguous United States. They are part of a unique population called the Southern Mountain Woodland Caribou, and they flit across eastern Washington and Idaho and into southern British Columbia, in a region known as the South Selkirk Mountain ecosystem.

"It's the only place in the country they exist anymore," said Ray Entz, George's boss and director of the Wildlife and Territorial Resources Division. He's built like a grizzly bear and speaks slowly, mulling over words and choosing them carefully.

Two hundred years ago, there were thousands of woodland caribou in the northern United States. Their range extended into parts of New England, the Upper Great Lakes, Montana, Idaho and Washington. President Theodore Roosevelt hunted them in Idaho, according to historical letters. By that time, near the turn of the century, their numbers had already begun to decline.

In Maine, two brothers shot the last caribou in 1854. By the 1970s, they had disappeared completely from the eastern seaboard and upper Midwest. In 2008, there were 47 caribou left, and they lived in the South Selkirk Mountains. Now there are twelve, and wildlife biologists are racing to save them.

Entz's agency, the Wildlife and Territorial Resources Division of the Kalispel Tribe of Indians, is part of a transnational recovery team consisting of several American and Canadian state, federal, tribal and provincial agencies. They've been trying to stymie the decline of caribou in the South Selkirks for over 30 years -- ever since the animal was listed on the Endangered Species Act in 1984. At that time, there were only around 30 caribou living in the South Selkirks.

They'd been decimated by a complex set of circumstances, some of which stem from the end of the Little Ice Age -- a 1,500-year global cooling event that began reversing in the 1850s. Woodland caribou, especially the ones that live in mountains, rely on arboreal lichen as a primary food source in the winter. It takes 80 to 150 years for this lichen to grow, so

it only exists in old forests.

A warming climate caused by the end of the Little Ice Age led to an increase in wildfires, which destroyed vast swaths of old-growth forest in western North America.

At the same time, millions of Europeans were moving across the country and chopping down trees, building roads and farms and settling down.

Clear cutting, wildfires and road building removed old forests and replaced them with younger forests, which attracted whitetail deer and moose. Their primary predators -- mountain lions and wolves -- followed suit. Snowmobile trails and logging roads gave them access into the higher terrain where the caribou lived.

“The caribou aren’t disappearing for any reason that’s natural,” Tim Layser, a wildlife biologist and former member of the recovery team, said. “It’s not strictly a climate change thing, though it does play into the mix. They’re a victim of our mismanagement of the forest over the last century.”

During the late 1980s and again in the mid-1990s, Layser and the recovery team attempted to augment the South Selkirk population with caribou from Canada. They captured a total of 103 woodland caribou from healthier herds in British Columbia, outfitted them with radio collars and loaded them onto trucks.

“We drove through the night,” Layser said from his office in eastern Washington. He’s middle-aged, sporting a mustache, and his voice is croaky from a bad cold he caught on vacation with his wife in Hawaii. “No stops other than gas and food. No hotels, none of that.”

After traveling the backroads to minimize stress for the animals, the trucks arrived in the South Selkirks.

“We’d lift the crates out of the back of the trucks, open them up and let them run,” Layser said.

The translocation bolstered the population, but the caribou were dying faster than they were breeding. By 2002, there were 34 caribou left -- only four more than when the program began.

“They were dying like crazy,” Layser said.

A mortality study revealed that a majority of the caribou were being killed by mountain lions, whose population had increased in recent years within the caribou’s habitat. The study found that a series of mild winters had led to an increase in whitetail deer, which are the primary prey for mountain lions. More deer meant more cats.

In response, local wildlife agencies in Washington, Idaho and British Columbia eased hunting regulations on mountain lions.

“We tried to cut the population in half, and we did,” Layser said.

More cats were killed, and caribou numbers began to slowly increase. By 2008, there were 46 living in the South Selkirks.

“Everybody was really excited,” Entz said. “Things were looking up and the numbers were going up.”

But then, a bull and a pregnant cow were struck and killed on a highway. Their deaths were an opening salvo to year after year of declines in the number of caribou in the South Selkirk.

At first, Entz says, biologists discounted the low numbers, chalking them up to faulty censuses -- bad weather clouding the vision of surveyors in helicopters and planes. But the numbers kept falling.

“We all started panicking,” he said.

By 2012, almost half the herd was dead. Entz and many of his counterparts on the recovery team uttered a single word when explaining these losses.

“Wolves,” he said and paused. “It’s the only thing that’s changed since 2008.”

That year, at least fifteen wolves began hunting in the South Selkirk ecosystem, according to data from the recovery team. By 2015, the British Columbia government figured that at least two caribou had been killed by wolves.

“We cannot have predation,” Entz said. At this point, every death was a tragedy to the herd.

So the recovery team took a drastic and controversial step.

Biologists in British Columbia radio-collared wolves from two of the three packs in the South Selkirks. Using helicopters and large-caliber rifles, and enlisting the help of professional wolf trappers, they tracked these wolves back to their packs. By the spring, they had shot and killed nearly a dozen. The hunt, part of a province-wide wolf management plan enacted in 2015, triggered an immediate outcry from environmentalist groups. Defenders of Wildlife issued a press release criticizing the use of “Judas Wolves” -- collared wolves who led hunters back to their packs, only to have them killed. Pop star Miley Cyrus condemned the shootings on Twitter.

Layser is conflicted by the wolf cull, as well. Since retiring from the United States Forest Service in 2009, he's worked for the Selkirk Conservation Alliance, a non-profit organization dedicated to protecting all that's wild in the Selkirk ecosystem, including wolves.

"I really hate to see it come to that. To have to sacrifice some wolves to save the caribou. But I'd hate to see the caribou disappear, too," Layser said. He sighed. "God, that's a tough one. To reduce the wolf population to allow the caribou a chance to survive... it's a kind of necessary evil."

Entz, the tribal resource manager, calls it triage. "You have a bleeding patient on the table," he said, "and there are a few things we can do, that are temporary in nature, that can stave off extinction and give us a chance at recovery."

Dave Hervieux agrees. He's a biologist at the Alberta Environment and Sustainable Resource Development ministry in Grand Prairie, Alberta.

"If the caribou don't die too fast, they'll do okay," he said.

Since 2000, Hervieux has been studying a population of around 100 woodland caribou in the Little Smoky region of Western Alberta. For the past eleven years, the Canadian government has shot or poisoned nearly a thousand wolves in an effort to save that herd from localized extinction, known as extirpation.

"It's reduced adult mortality and increased calf survival, period," Hervieux said. "That's a victory."

However, he doesn't think wolf management is enough to save a caribou population in the long term.

"If you grind up caribou habitat, why bother to save them?" he said. "The overwhelming evidence is that the declines in caribou are coincidental with the development of the country. In places where we haven't developed, the caribou aren't doing too bad."

What the caribou really need is more wild habitat. More old-growth trees and fewer roads and trails that allow predators to find and kill them. In 2007, the government of British Columbia protected nearly 400 square miles of caribou habitat in the southern Selkirks, banning logging and road-building. That's a space larger than the city of New York.

When the United States tried to pull off a similar feat, however, it failed.

In 2011, the United States Fish and Wildlife Service proposed protecting 570 square miles of Idaho and Washington for the South Selkirk caribou. However, the government scaled

back their proposal to a mere 46 square miles in 2013, arguing that, since the caribou spent most of their time in British Columbia, efforts to protect the species in Canada were adequate.

To Entz and Layser, it seems like the federal government is cutting its losses on the dwindling number of woodland caribou and passing on responsibility to the Canadian government. And that's an easy thing to do, because there's very little public pressure to save these animals in the United States. In fact, many Americans don't even know they exist.

"You go anywhere around here and talk to people, they don't have the foggiest idea that we have caribou living in the United States," Layser said. "It frustrates me to no end."

Entz shares this sentiment.

"It's absolutely shocking that we have caribou in the United States and nobody seems to care," he said. "We used to eat caribou. They were a winter food source for the tribe. I don't want to be the biologist working with the tribe the year caribou go extinct in the [lower] United States."

Entz would like to see the caribou population recovered to the point where Kalispel tribal members could hunt them again. The team is making small steps towards that goal -- erecting a radio-activated sign that warns drivers of caribou crossing a highway in British Columbia and drafting an updated recovery plan -- but it's becoming an almost Sisyphean feat.

"When you get to twelve animals, you're in a world of hurt," Hervieux said. "Is it too late? I'm not going to say that, because I don't know. But you get to a point where it's too late."

"They're functionally extinct," Entz said, meaning the population isn't a viable player in the ecosystem anymore.

It barely exists. A ghost of itself.

Tim Layser has worked with the animals for almost three decades. He's now retired. Still, most winters, he takes off from a small airport in Priest River, Washington.

Engine roaring, Layser surveys the snow and pine-speckled terrain for caribou. The dark brown fur. The antlers arching towards the sun. He hasn't seen one in two years.

"There used to be thousands of caribou in the lower 48 states. But now it's just this small handful left, and it's going to be gone very soon," he said. "It's going to be gone in my lifetime."