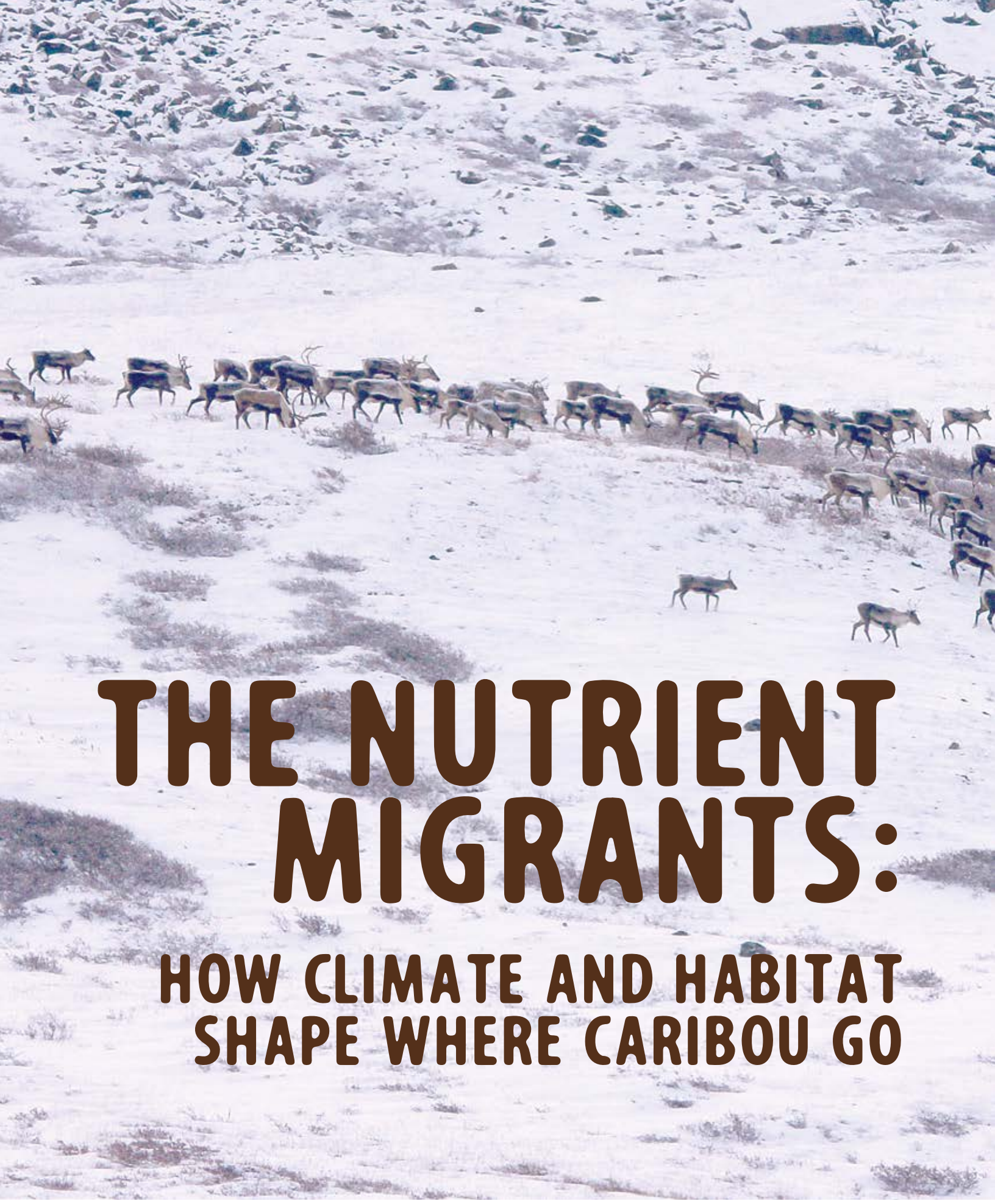

THE NUTRIENT MIGRANTS:

HOW CLIMATE AND HABITAT SHAPE WHERE CARIBOU GO

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Photos Courtesy of Authors

CARIBOU BULLS FORAGING ALONG THE RIVER IN DENALI NATIONAL PARK.

"Where are the caribou?"

That's the million-dollar question for hunting barren ground caribou in the arctic. Hunters seek big males, but managers and researchers are really focused on females and their calves that grow to become trophy bulls and strong mothers.

In the fall hunting season, big males move with females and young into wintering ranges away from the coast. But during the summer, females move much further north than males to calve on the coast. And as it turns out, females have different nutritional needs that may drive them to go to different places than the males—factors which may affect the ability of caribou herds to persist in the arctic.

THESE HOOVES ARE MADE FOR WALKING

What would you do if you were trying to fill up your gas tank, but each gas station only let you partially fill up your tank? Obviously you'd try to find some rhyme and reason to the madness, and if certain gas stations let you fill your tank up more, you'd head for those prime spots, even if you might have to travel a bit further.

That's the same rationale behind one theory about why caribou migrate such long distances and space themselves out differently. Females, driven by differing nutritional needs, spend more time on the coastal plains near the Arctic Ocean compared to their more inland-friendly mates.

In particular, females need more protein than males. Sure, males still need protein to build their gigantic muscles (as any bodybuilder can appreciate), but they don't have to use protein to build a brand-new calf and then produce enough milk to support it after it's born. These activities also require a lot of minerals, especially calcium and phosphorus.

It's these nutritional differences that some of the first wildlife scientists in Alaska speculated could cause the differences in migration patterns we see between males and females. It's also why we decided to test this question once and for all—how do minerals and protein change within the ranges of arctic caribou herds, and does that match up with where we see the caribou going?

THE TUNDRA: NOT JUST ONE BIG SWAMP

When you look out over the tundra, it's easy to think that it's just one giant swampy field all the way to the coast. But in fact, if you dig down and look at the differences between the plants and where they're located, you can see that there's actually a lot of variation. It's this variation that makes all the difference.

For example, people used to assume that all shrubs were the same. When people measured how much protein was in the shrubs, they always came out with a uniform answer: lots of protein. From this perspective, shrubs looked like a protein goldmine.

However, when we looked at how much of that protein was actually available to the animal, the results were astounding. Some species of shrubs, like Richardson's willow (*Salix richardsonii*), did indeed contain a lot of protein. But other shrubs, like dwarf birch (*Betula nana*) contained so little protein and so many toxins and other noxious chemicals that caribou might actually lose protein in the process of digesting it, much like a protein sponge. This presents a much more nuanced picture and means that shrubby areas of the tundra (like those found inland) may not be as great for females looking to pack on protein as we once thought.

In fact, when we looked at the best areas for protein gain, we found that the coast was without a doubt the place to be for females with a calf in tow. By staying on the coast, females could continue packing on extra protein for 17 days longer than if they had stayed

Richardson's willow range.

NOT ALL SHRUBS ARE THE SAME.

Some species of shrubs, like Richardson's willow (top), indeed contain a lot of protein. But other shrubs, like dwarf birch (bottom) contained so little protein and so many toxins and other noxious chemicals that caribou might actually lose protein in the process of digesting it.

Dwarf birch range.

inland with the males.

This was mostly because the coastal plain was full of sedges and other plants that had low—but consistent, and toxin-free—amounts of protein. Females may be able to get more protein by only eating certain shrub species inland, but this isn't a guarantee. By heading to the coast where there's fewer toxic shrubs, they're playing a safe hand.

MINERALS MAY ALSO DRIVE MOVEMENTS

Another thing we found was that minerals varied across the range—sometimes tremendously. Two of the biggest examples were sodium and phosphorus, which we found in higher concentrations near the coast. The influences of the salt water in these areas creates a sort of de-facto salt lick that caribou can use. These minerals are especially important because they help regulate fluids in the body and build bones—something very important to females putting out lots of milk for growing calves.

One of the odd aspects of minerals is that they sometimes interact with each other or are found in wildly different concentrations in different parts of the range or at different times of the year. For example, both calcium and phosphorus are really important for antler growth and reproduction. But, too much of one of these nutrients will limit absorption of the other, and so caribou need to walk a fine line of balance. This is difficult to do because calcium and phosphorus levels change over time: in growing plants, phosphorus generally decreases over the season while calcium generally increases. It's like trying to stay upright while walking along a seesaw mounted on a boat deck in the middle of the ocean.

Another poignant example is sodium, which caribou desperately need after long winters of foraging on inland lichens. Without access to their coastal sources of salt in spring, caribou could become sodium depleted due to the high concentrations of potassium in new plant growth.

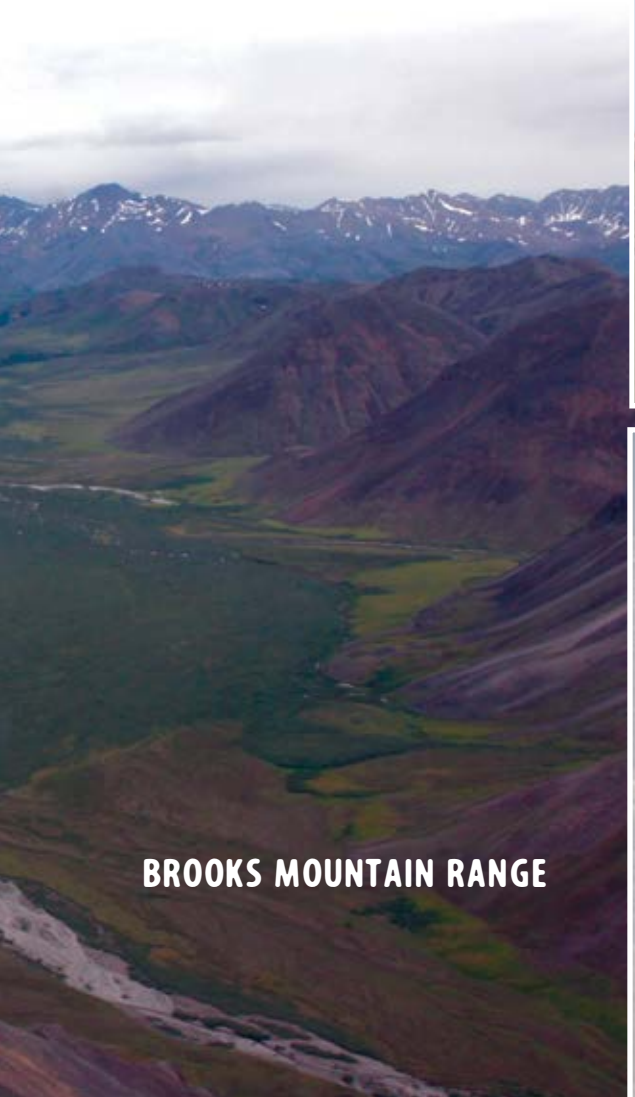
These examples highlight just how difficult it is for caribou to get just the right amount of each mineral. A caribou might spend time in one area trying to beef up its stores of one mineral, for example, only to have another one become deficient in the process, and so it might need to move to another area entirely.

It's a careful balancing act that's impossible to get 100 percent right, but the closer they're able to get, the better their chances of maintaining a healthy body that can deal with whatever challenges nature (or civilization) throws at it.

DO NUTRIENTS EXPLAIN ALL CARIBOU MOVEMENT?

We found that for caribou looking to meet their nutritional requirements, they generally are found exactly where they need to be. Females head to the coast to get much-needed protein and minerals, while males can pack on more muscle and fat for the fall rut by staying further inland.

However, this may not be the only reason driving caribou to migrate such long



ABOVE: Caribou might be able to adapt to increasing development, as David Gustine observed they have done in the Prudhoe Bay oil fields, but this tolerance depends on other demands and doesn't appear to be the same in every location.
LEFT: Lindsay Van Someren working on the North Slope along the Dalton Highway.

distances. Because of the close proximity to the ocean, the coastal plains are far windier and may provide a much-needed reprieve from pesky mosquitoes and parasitic flies for calves and their mothers. In Alaska, the coastal plains are also far away from the mountains—and the predators who live in them. Indeed, calf survival rates for caribou herds who birth their calves on the coastal plains are often much higher than their inland relatives.

These are also possible explanations for caribou migration. But one thing we do know from our research is this: the coastal plains are incredibly important for female caribou and their offspring. Without the coastal plains, individual female caribou may have a harder time meeting their nutritional requirements, and this effect could scale up and negatively affect the population as a whole.

WHAT'S IN STORE FOR THE FUTURE OF THE ARCTIC CARIBOU RANGES?

We do know that the composition of the landscape is changing in the arctic. Toxic shrubs like *Betula nana* are increasing in abundance and slowly moving northward, which may make it harder for females to get enough protein to grow calves over the coming decades.

Proposals to develop oil and mineral extraction is increasing in the Arctic as sea channels are staying open longer each year. Although caribou might be able to adapt to increasing development as they have done in the Prudhoe Bay oil fields, this tolerance depends on other demands and doesn't appear to be the same in every location.

In addition, even if caribou females and their calves shun the developed areas (and the high-quality forage in them), it's possible that they can compensate by eating more and/or finding other high-quality patches of forage. In good summers, this may be a viable strategy; but in bad summers, it may not be possible and the population may suffer declines, as we saw with the decline in some caribou herds after the Mt. Pinatubo eruption in 1991.

Obviously a lot of questions still remain. Will the caribou tolerate development? If not, will they be able to compensate in other areas? How much of a buffer do they have to tolerate development if they do move to other areas? How big of a decline would they suffer if they can't compensate? At what point is the population no longer viable? How can we quantify this better?

Businesses that operate in the arctic have a long history of employing economists, accountants and other "number-crunchers" to assess the viability of commercial operations. But it's only recently that we've started to do the same sort of analyses of profits and losses in body mass of mothers and calves to assess the viability of caribou populations in the Arctic. Neither business nor biology is certain, but with better numbers, we can help reduce that uncertainty so that both can better coexist. ■

Keith Oster servicing a weather station.

WESTERN ARCTIC CARIBOU.