EXECUTIVE SUMMARY

June 2026

CARIBOU FUTURES — ASSESSING VULNERABILITY OF MIGRATORY TUNDRA CARIBOU TO CLIMATE CHANGE

This Executive Summary examines how three migratory tundra caribou herds will be affected by rising temperatures, and provides recommendations on what measures can be taken to protect the herds.

Why we did it

With the climate projected to continue warming, even under the best-case scenario of society's ability to curb greenhouse gas emissions, we urgently need to plan for and act on threats to Arctic biodiversity. A warmer climate will harm caribou through heat stress and increasing insect harassment during the summer, and rain-on-snow events during the winter.

Both the overall magnitude and the regional variation in climate change and its effects on vegetation will influence how caribou herds develop in the future. To improve our understanding of this and to support long-term conservation efforts, WWF has commissioned a study by caribou experts Anne Gunn and Don Russell. This research will help identify which herds are most vulnerable and in need of targeted management support.

What we did

We examined how three migratory tundra caribou herds living in different regional climates and vegetation are expected to fare under a best- and a worst-case warming scenario (*see sidebar, page 3). We modeled how warmer summers impact caribou body condition which in turn impacts trends in abundance. While the three herds were projected to shrink due to reduced pregnancy rates and calf survival, the extent of their reduction varied based on the regional climate and vegetation.

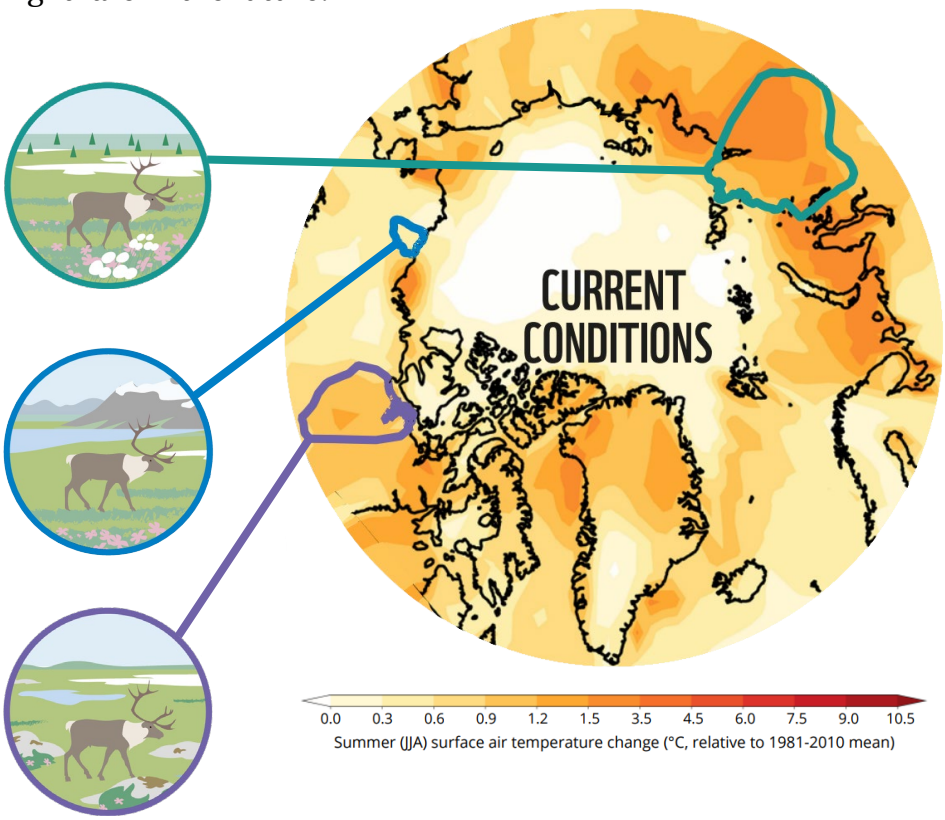
How we did it

We selected three representative migratory caribou herds based on the regional climate (continental vs oceanic) and ecology (vegetation based on bedrock, vegetation and landscape) to investigate how they might fare in the future:

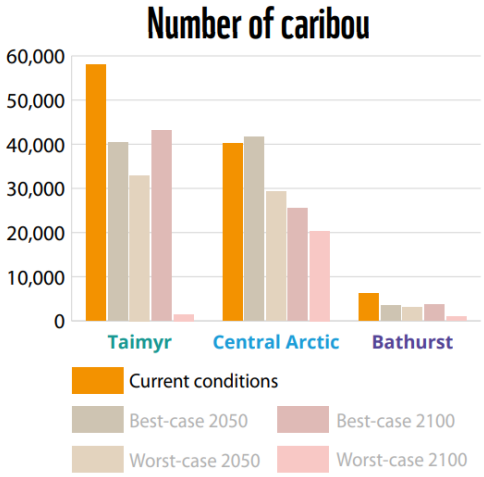
The Taimyr herd (TAI)
continental climate, gradient of shrub- to moss-lichen dominated tundra with sparse herbs, low lying topography.

The Central Arctic Herd (CAH)
oceanic climate; forb-rich tundra on flat, lake-rich landscape

The Bathurst Herd (BAH)
continental climate; sparse tundra, landscape with rocky outcrops



We used known caribou vital rates and identified which climate indicators in late spring and summer they are sensitive to. Next, we predict how these climate indicators might change with the summer monthly mean temperatures - this tells us the herds' exposure to climate change. Finally, we used the Caribou Cumulative Effects (CCE) model to project how the different climate change scenarios would impact cows' pregnancy rate and calf survival in each herd to determine the potential impacts of the warming. Based on these results, we examined the adaptive capacity of the three herds.



What we found

While all three herds are projected to decline under the best- and worst-case scenarios by 2100, the modelling reveals strong regional impacts:

- The Bathurst herd is projected to see the most summer warmth, number of hot days and the **highest rate of decline.**
- The Central Arctic herd on its cooler coastal range is projected to be the **least affected**.
- The extent of warming and subsequent effects on the size of the Taimyr herd are expected to be between those of the Central Arctic and Bathurst herds.

Mean monthly temperatures in the worst-case scenario will exceed historic maximum temperatures for all herds by 2100. For the Bathurst herd, already in 2050 mean monthly temperatures in summer ((June, July, August) are expected to exceed historical maximum temperatures. Those higher temperatures will result in increased insect harassment and more days with heat stress, reducing the time available for foraging. For the cows, body weight determines the likelihood of pregnancy and for the calves, it influences their survival. The interplay of the likelihood of pregnancy and survival of calves results in the changes in the size of the herds. In the best-case scenario all three herds showed relatively little change until around 2050, followed by more substantial declines by 2100.

ABOUT THE MODEL

The possible climate futures are based on two scenarios of emissions and socio-economic development from the IPCC Sixth Assessment Report. The best-case scenario, in which global emissions are limited to 1.5°C, corresponds to the Shared Socioeconomic Pathway (SSP) 1-1.9 and the worst-case one, where warming exceeds 4°C, corresponds to SSP 5-85[1].

The condition of the herds was assessed at two key timepoints: mid-century (2050) and the end of the century (2100).

The Caribou Cumulative Effects (CCE) model is based on ecological data, and links vital rates to relevant climate variables. This informs the probability of pregnancy for caribou cows and the likelihood of calves surviving their first winter, which in turn influence how herd sizes change.

1 IPCC AR6 WGI Summary for policy makers.

The herds in more detail

Central Arctic herd

The oceanic range of the Central Arctic herd has lower summer temperatures and is expected to warm the least of all modelled ranges. Impacts on the herd are therefore expected to develop more slowly. Under the worst-case scenario the Central Arctic herd is expected to decline 1% per year more than current conditions by 2050, rising to 5% per year more by 2100.

Bathurst herd

Among the three herds, the Bathurst herd is projected to be the most impacted by future warming. Its continental and bedrock dominated range is characterized by warmer summer temperatures and frequent drought conditions. Under the worst-case scenario, this herd is projected to decline by 4% (2050) and 10% (2100) annually.

Taimyr herd

The Taimyr herd's range has a later green-up, fewer growing degree days, less insect harassment, lower precipitation and less frequent drought conditions and its peak of calving is almost 3 weeks later. These attributes both positively and negatively impact cow and calf growth. Projected temperature increases are between those of the Central Arctic herd (low), and Bathurst herd (high). Under the worst-case scenario, this herd would annually decline by 1.2% (2050) and 11.2% (2100).

Calving at higher temperatures

The peak of calving varies among herds and is influenced by the timing of vegetation availability in their respective calving grounds. As the climate warms, this vegetation is expected to reach its peak earlier across all regions. Earlier calving could help to buffer the impacts of this shift, but there are limits to how much calving can change, as breeding is linked to day length in the fall and the gestation period length is relatively fixed.

If the herds were able to calve one week earlier, the regional effects would again be expected to vary, depending on the severity of climate change. In the worst-case scenarios, this shift could lead to slightly larger calf weights for the Bathurst and Taimyr herds — both more negatively affected by projected climate warming — while calf weights for the Central Arctic herd would likely remain similar.

EXTRAPOLATION OF OUR RESULTS TO OTHER HERDS

Results of our modelling could broadly be extrapolated to other caribou herds with similar climate and environmental conditions.

The ranges of the Blue Nose East, Beverly, Ahiak and Qamanirjuaq herd's ranges are continental and on the Precambrian Shield as those of the Bathurst herd and are expected to be more strongly impacted by rising temperatures.

The Teshekpuk Lake, Porcupine, Cape Bathurst, and Blue Nose West herds share similar current summer climatic environments as the Central Arctic Herd (colder summers, forb-rich tundra on sedimentary substrates) and expected to be similarly less strongly impacted.

How can we turn these findings into action?

Keep landscapes open and connected and protect calving and summer ranges from disturbance: Caribou rely heavily on their seasonal migrations and spatial memory to adapt to changing conditions. They can adjust their movements in response to seasonal and annual environmental variations, as long as their paths are not obstructed.

Ensure effective herd management under climate change: Governments and co-management bodies collaborating can ensure that science and Indigenous Knowledge are used together and complementarily. This will provide the best-available information for herd management, based on herd characteristics, assessments incorporating climate change effects and providing an indication of risk of different harvest rates. Mitigation plans that are based on such proactive monitoring of herds could mitigate the impacts of the worst-case climate scenario.

Effectively limit greenhouse gas emissions: For all three herds, the models show that their adaptive capacity —as currently understood — will not be enough to mitigate the impacts of a high-warming future. Without effective limits on greenhouse gas emissions, some migratory tundra herds risk dwindling to small remnant populations or disappearing altogether.

CAVEATS TO THE MODELLING APPROACH:

The projections of how migratory tundra caribou may respond to a warming climate over 25- and 75-year timeframes are intentionally conservative. They focus primarily on the calving and summer seasons, since the uncertainties in modelling future precipitation limited how we could include impacts of changing winter conditions. Rain-on-snow events are therefore not included, and we may underestimate the full range of potential impacts.

This narrow focus, combined with other limitations in the modelling approach, increases the risk of unexpected ecological surprises or tipping points — emphasizing the need for decisive action to stay within the best-case scenario.

Additionally, the model does not account for the cumulative impacts of industrial development, such as roads and traffic, further amplifying the uncertainty of the projections.

Suggested citation:
WWF Global Arctic Programme. 2026. *Executive Summary: Caribou Futures*. Solna. Sweden

Visit arcticwwf.org