

Initiatives

the project team and authors to design and adjust the content and frame of the report, and more than 80 stakeholders and scientists reviewed the final work.

The resulting report was used as a background document for an international conference held at Reunion Island in July 2008. This conference was an official event of the French presidency of the European Union, aiming to raise awareness about climate change impacts in the European Overseas Territories and to develop a network to build a coordinate adaptive capacity for these territories.

The report "Climate Change and Biodiversity in the European Union Overseas Entities" is available online: www.iucn.org/about/union/secretariat/offices/europe/resources/?1209/

Guillaume Prudent - guillaume.prudent@maunsell.com works for Maunsell AECOM and is a Departmental Visitor in the Fenner School of Environment and Society (Australian National University).

Caribou of the Canadian Rockies: Understanding Environmental Change in the Context of Conservation and Evolution

Byron Weckworth

Global temperatures were increasing, massive sheets of ice at the higher latitudes were rapidly melting and receding, exposing tracts of bare soil that had lain covered for millennia. Ocean levels were rising, flooding and enveloping coastal terrestrial habitats. The Ice Age was coming to a close, and, during this period of dramatic climatic amelioration from a cold Earth to a warm one, the world's biodiversity was being shuffled about. Flora and fauna everywhere experienced the carnal influences of selection - either adapt to the changing climate, or perish.

In North America the last glacial maximum is known as the Wisconsinan. At its peak, two huge ice sheets, the Laurentide and Cordilleran, covered much of modern day Canada and the northern region of the contiguous United States. These massive glaciers effectively isolated the Beringian sub-continent and high arctic to the north from regions south of the ice. Wildlife populations that had been adjoining prior to glaciation became disjunct and isolated from one another, an evolutionary mechanism often leading to increased biodiversity. An icon of the northern latitudes, the caribou (*Rangifer tarandus*), provides the perfect example. To the north, caribou adapted to the barren-ground tundra habitats and are now recognised as the subspecies *R. t. groenlandicus*. These barren-ground caribou persist in large herds and have the behavioural propensity for long-distance seasonal migrations. South of the glacial ice, caribou adapted to a much different habitat type in the forests, and are recognised as the sub-species *R. t. caribou*. These woodland caribou tend to be more spatially distributed, have smaller herds, and are sedentary, in contrast to their barren-ground brethren. As the glaciers fully receded, this intra-species diversity provided an adaptive advantage that allowed caribou to expand and prevail across most of Canada, while still retaining the barren-ground and woodland distinctions. However, today, across a landscape



Mountain caribou bull. Photo: Mark Bradley.

that is now heavily impacted by humans, the woodland subspecies is formally classified as threatened. As conservation efforts mount, a better understanding of caribou diversity is necessary in order to enact effective management strategies.

Evaluating and understanding caribou diversity

In the Canadian Rockies, caribou diversity becomes further complex. In the province of Alberta, a region dominated by natural resource extraction activities, woodland caribou are split into mountain and boreal ecotypes, based loosely upon their distribution and behaviours. The imprecision of the ecotype designations and their threatened status produced an environment ripe with urgency for scientific research to help clarify and guide policy and management directives. To that end, in early 2007 an interdisciplinary and multi-institution collective initiated the Canadian Rockies Woodland Caribou Project (CRWCP) to broadly determine causes for decline in woodland caribou of Alberta and British Columbia, with emphasis on declining populations in the Canadian Rockies. After only the first two years of the project, the CRWCP's first scientific publication (McDevitt et al. 2009) uncovered some amazing and unexpected results, the foremost of which is revealing a "hybrid swarm" of caribou in the Canadian Rockies of Alberta and British Columbia.

Caribou biologists had previously noted that some caribou in the Canadian Rockies had distinct summer and winter ranges. The spatial isolation of these ranges suggested some behavioural form of seasonal migration, a trait akin to barren-ground caribou, not the woodland subspecies. Through

telemetry and Geographic Information Systems methods, the CRWCP has been able to clarify and further describe these migratory behaviours. In the caribou analysed, some herds were either entirely migratory or entirely sedentary, while other herds are mixed, with different individuals exhibiting either behaviour. This brings us back to the “hybrid swarm”, a unique group of individuals that result when two distinctive groups interbreed. As the Laurentide and Cordilleran ice sheets retreated around 14,000 years ago, the gap between them created a corridor, linking the previously isolated regions north and south of the glaciers. Geologic data indicate that this ice-free corridor was along the eastern slopes of the Canadian Rockies. Genetic information (McDevitt et al. 2009) suggests that the two caribou subspecies expanded into this newly available habitat and interbred extensively. The “swarm” of caribou created a group of hybrids that have DNA signatures showing mixed ancestry of both historic caribou subspecies. This mixed gene pool has resulted in a group of mountain caribou with characteristics unique from their historic parents. Individual analysis showed that mountain caribou with a barren-ground ancestry were more likely to be migratory. This correlation of genetic evolutionary history with contemporary spatial behavioural dynamics is rare. It is conceivable that the unique mixture of woodland and barren-ground ancestry has provided the genetic diversity, and hence flexibility, that has enabled caribou to persist in the variable and challenging landscape of the mountain ecosystem. The preservation of this genetic diversity is as imperative to caribou survival as is ensuring adequate numbers. This mixture contributes not only to the overall diversity of caribou, but also to the biodiversity of the Canadian Rockies.

But why are caribou populations in decline?

Widespread opinion blames increased wolf predation and loss of habitat for caribou declines. The increase in predation may be linked to human impacts on the landscape and changes to predator-prey dynamics. Industry activities related to natural resource extraction, such as timber and oil/gas, lead to an increase in artificial features such as roads, pipelines, seismic lines, clear cuts and oil/gas well pads. The presence of these features may lead to increased efficiency of wolf predation, resulting in increased predation on caribou. These changes to the landscape may also affect general primary prey

productivity. If the human footprint on the landscape creates habitat types that favour moose, moose numbers may increase. Moose are a primary prey species of wolves: as moose numbers increase, so do wolf numbers. More wolves in the ecosystem might lead to an increase in incidental wolf-caribou predation events. Other primary prey species (e.g. elk and deer), the effect of habitat loss, changing industry practices and climate change further complicates this already multifaceted system.

Beginning to understand the evolutionary history of these caribou is an essential first step. Further research is necessary to detail landscape level patterns of genetic diversity and the influence of contemporary habitat change. Yet, clearly, in order to fully understand the plight of caribou and how best to change policy in order to save them, we must unravel the problems as they relate to the entire ecosystem and our role in it; this is where the Canadian Rockies Woodland Caribou Project (CRWCP) now extends its effort.

An unknown future

The planet is once again undergoing dramatic habitat and climatic alteration, with humans appearing as the catalyst for change. As the world's flora and fauna struggle to adapt, it remains to be seen how much will be lost. The situation for woodland caribou is dire. Science alone cannot resolve this calamity. Continued support among industry, government, and the public is necessary to ensure any possibility of success. Conservation efforts cannot flourish at the whim of economic booms, only to be forgotten when the economy fails. A consistent and resolute priority must be placed on understanding and resolving our environmental crisis. Alleviating our predicament requires more than action alone; success will not be measured by saving species or averting global warming, but rather by changing a global philosophy.

Reference

McDevitt, A D; Mariani, S; Hebblewhite, M; DeCesare, N J; Morgantini, L; Seip, D; Weckworth, B V; Musiani, M (2009) *Survival in the Rockies of an endangered hybrid swarm from diverged caribou (Rangifer tarandus) lineages*. Molecular Ecology, Vol 18(4). pp. 665-679.



Dimsdale Lake, British Columbia, in the heart of mountain caribou habitat. Photo: Byron Weckworth.



Migratory mountain caribou in summer range. Photo: Mark Bradley.

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Byron Weckworth bvweckwo@ucalgary.ca is a member of the North American Mountain Forum.

Thoughts on the Food Crisis in the Andes

Judith Kuan Cubillas

In August 2008, CONDESAN, as a co-sponsor with the Secretary General of the Andean Community's office, the Andean Initiative of Alliance for the Mountains, FAO, and Swiss Agency for Development and Cooperation (COSUDE), held an online conference: "The Food Crisis: Challenges and Opportunities in the Andes".

This article presents some relevant notes and thoughts regarding the conclusions and recommendations from the conference. In this conference the concept of "food crisis" meant not only the 'increase in food prices' but also 'food safety and nutrition'.

Main conclusions

There is a consensus regarding the factors that influence the food crisis and the increase in the price of food at a global

level. The factors can be classified according to their nature: temporal and structural. Due to their recurrence and influence on the terms of trade, some temporal factors can ultimately be grouped together with repercussions of a structural nature.

Temporal factors

The increase in energy prices.

- The increase in the price of fuels has made the production, transport and commercialisation of food products more expensive. Although at some point in time the prices of fuels will go down, the costs of production and commerce will not decrease, neither in proportion to nor with the speed with which the prices of energy will drop, affecting most small-scale agricultural and livestock producers.

Reduction in the supply of food (production, reserves, and exports)

- The decrease in the production of food, when referring to temporal factors, is a result of the natural disasters that take place. Subsequently, the use of reserves and the prohibition of exportation by countries with surpluses have intensified the lack of availability of food, followed by the consequent pressure from a rise in prices.

Speculative and financial pressure and subsidies

- Speculative factors and non-transparent factors have also impacted the rise in the price of foods: speculative pressure regarding basic products, as a result of the global financial crisis; the increase in liquidity in certain parts of the world; and the interest shown by investment fund managers in the future market possibilities for 'commodities'.
- Additionally, the recurring continuity displayed by industrialised countries to maintain high levels of subsidy and protection for agricultural and livestock production continues to distort the transparency of market prices, forcing pressure for the increase in prices of basic products.

Structural factors

The most important factors of a structural nature that affect the global food crisis can be looked at from the standpoint of demand and supply.

Demand driven:

- The high rate of growth of the world's population within the last five decades and its projections for growth give a glimpse that, in general terms, 50 percent more food will need to be produced in order to satisfy the needs for food.
- There is a greater demand in quality and variety of foods derived from the increase in demand from middle class sectors of the population, given the economic development of emerging countries and the greater degree of migration to urban areas.

Supply driven:

- The development model for agriculture and livestock that has been applied has given a higher priority to production for export over that of support to rural economies for the production of items for the national food supply. Additionally there has been a drastic reduction of participation by the State in planning rural development and providing of services, leaving it to market forces.