

Nutritional ecology of reindeer/caribou and their interaction with humans

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For arctic and subarctic animals, the availability and quality of food is highly seasonal. Indigenous herbivores have adapted behaviorally and physiologically to climatic extremes, shaping their nutritional and reproductive strategies. Of particular importance is the availability of energy and protein, which are frequently uncoupled. Between-year weather variations, long-term climatic changes, and regional gradients in productivity combine to further alter annual distribution and seasonal migrations.

The historical distributions of native peoples coincide closely with their food resources. With primary dependence on a single species, welfare of the user is intimately tied to that food base. In circumpolar regions, reindeer/caribou (*Rangifer tarandus* L), offer a good example. Reindeer herding by the nomadic Saami and other native groups of northern Europe and Eurasia (1) and caribou hunting by the Gwich'in of Alaska and Western Canada (2) have long traditions. In these cases, short- and long-term changes in the quality and quantity of vegetation available to the herbivore could cascade through the food chain to the user (3).

The relative effects of energy and protein on individual female caribou result in five reproductive pathways that control annual fecundity and nutritionally evoked mortality (4). When adjusted for natural mortality and hunting, level of nutrition strongly determines caribou population size (5). Factors affecting energy intake of female *Rangifer* during summer influence the level of fatness attained by autumn, thereby controlling conception rate (6,7). In contrast, protein balance in spring influences weights at both birth and weaning, in turn affecting survival. Access to nitrogen-rich forage during the first three weeks postpartum is especially important to maximize milk production and calf survival (5). Later in summer, maternal protein deposition becomes a priority, and if the female cannot deposit protein at 60 g/d, milk production ceases, and the calf will die (4). If the calf survives, however, nursing may continue until the autumn rut; but under poor nutritional conditions, females may wean early or forego breeding and suckle calves throughout winter (4).

Reindeer milk was traditionally stored for winter use (1). Reintroduction of milking could provide economic benefits to Saami and stimulate research on maximizing milk production. Future husbandry practices may focus on the unique aspects of reindeer milk and the potential for marketing exotic cream and cheeses (8).

Until recently, diets of reindeer herders and caribou hunters were relatively high in protein and fat (2,9). Local red meat was supplemented with smoked fish and marine mammal products. Bone marrow, fish, and marine mammal oils were sources of unsaturated fatty acids. Willow leaves and berries were stored in oils, preserving the vitamins, and eaten with meat and fish during winter. Apparently births were distinctly seasonal, attributable to a pulse in food availability. The diet is now higher in carbohydrates and comparatively lower in protein and fats, and the year-round availability of store-bought groceries has moderated the nutritional pulse (9). Changes in diet and exercise have occurred, as has increasing incidence of obesity and diabetes (10). Ischemic heart disease has not declined among Alaska Natives, as it has among others in the US, and it may be increasing (11).

Nutritional challenges abound. Reintroducing components of the traditional diet that provide protection from metabolic diseases is but one important goal, but success is elusive. Herding and hunting traditions assist in social well being, but monetary returns are low. Uncertainties about the future of the resource base, especially in light of industrial development, tourism and climate change, also make for an uncertain future. However, documenting native ways of knowing and combining western science with traditional knowledge and observed ecological indicators are important new approaches for co-management of wildlife resources. These represent important tools given the emergent politics of northern self-determination (12). Nevertheless, complex systems and diverse goals lead to conservative management schemes which, without thoughtful implementation, will limit either the number of families or the extent to which individuals and families can retain the basic elements of a subsistence lifestyle (13,14). This, in turn, will reduce the consumption of traditional foods, which are powerful tools for reducing and preventing the incidence of nutritionally based health issues.

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