Mountain Caribou in British Columbia: A Situation Analysis

Mountain Caribou Science Team *19 May 2005*

An objective of the new Species at Risk Coordination Office is to develop recommendations for recovery of mountain caribou to deliver to government for decision-making during 2005. As an initial step in this process the following summary has been prepared to describe the current situation facing mountain caribou in British Columbia.

British Columbia's Mountain Caribou in a Global Context

Caribou (*Rangifer tarandus*) are found in the arctic tundra, mountain tundra, and boreal forests of the northern hemisphere[1]. Historically, caribou populations inhabited nearly all northern latitudes, but they have been extirpated from most of Europe and eastern North America and are currently restricted to the more northern latitudes of North America, Russia, and Scandinavia. Current global populations are estimated at approximately 5 million and, although some are expanding, most are in decline at various rates. Caribou are important to most northern indigenous people for food and clothing and consequently the geographical distribution of some indigenous groups reflect the historic distribution of caribou. This importance resulted in the domestication of reindeer (the same species as caribou) in Eurasia approximately 7000 years ago.

Globally, caribou have been separated into seven to nine subspecies based on geographic location, behaviour, and ecology. Three subspecies are found in Canada; the barren ground and Peary caribou (*Rangifer tarandus groenlandicus* and *R. t. pearyi*), which are found predominantly in tundra environments, and the woodland caribou (*Rangifer tarandus caribou*), found predominantly in coniferous forests and muskegs. The Committee on the Status of Endangered Wildlife (COSEWIC) has identified several national populations of woodland caribou as *Threatened* or *Endangered* under the federal *Species at Risk Act* (SARA)[2]. The national population of woodland caribou inhabiting the Southern Mountains National Ecological Area (SMNEA), which covers most of the southern and central interior of British Columbia, is listed as *Threatened*.

Three different "ecotypes" of woodland caribou are recognized in BC: boreal, northern and mountain[3]. About 1500 boreal caribou reside in the Peace River region and are geographically linked with boreal caribou populations that occupy ranges throughout Canada's boreal forest as far east as Newfoundland. There are approximately 15,000 northern caribou in BC and, as a result, this ecotype is considered relatively secure[4]. The mountain ecotype (hereafter "mountain caribou") resides in the wet forests of central and south-eastern BC and is the ecotype of greatest concern. The Provincial Government considers mountain caribou to be *Endangered or Threatened* (i.e., the BC Conservation Data Centre's Red List). The estimated population of mountain caribou was less than 1700 as of 2002, and many subpopulations have experienced declines of 50% or more in the past 10 years.

Mountain caribou are among the southernmost populations of caribou in the world, a result of favourable habitat conditions created by the relatively wet and mountainous terrain of their range. Over geologic time, caribou populations have likely advanced and retreated with glacial events. As a result, mountain caribou populations have probably existed in southern BC for greater than ten thousand years[5]. Nearly the entire current range of mountain caribou occurs in British Columbia. There is a small subpopulation that moves between BC and northern Washington and Idaho. Historically the range of mountain caribou extended farther south into the US and was more extensive in southern BC. Both the atypical range of mountain caribou and their unique life history make this ecotype globally significant.

Critical Aspects of Mountain Caribou Biology

Mountain caribou are distinguished from other ecotypes by their behavioural and ecological characteristics, rather than by genetics[6]. Genetic analyses have concluded that mountain caribou and other woodland caribou ecotypes are genetically similar, suggesting that the unique behavioural and ecological characteristics of

mountain caribou have evolved without long periods of isolation from other ecotypes (perhaps even evolving more than once, judging by genetic differences among mountain caribou subpopulations).

Mountain caribou have adapted to the deep snow and rugged terrain of their range by occupying large patches of mature and old forest at high elevations throughout most of the year. During winter when snow is sufficiently deep and consolidated, mountain caribou's relatively large hooves allow them to travel on top of the snow pack and feed exclusively on lichens that hang from the branches of older trees. These arboreal lichens are most common in mature and old forest stands, but they will also grow in younger forests if the structure of the stands is suitable. Arboreal lichens are one of the few foods available to caribou above the snow in the subalpine in the winter. Caribou move seasonally to lower elevations, but only to reach green vegetation in spring and again in early winter when snow at higher elevations has yet to consolidate, making it difficult for animals to move efficiently or to reach arboreal lichens. Some caribou move to windswept ridges in early winter to avoid unconsolidated snow.

Spreading out over large areas at high elevations is essential for mountain caribou to avoid predators. In winter they occupy habitats that other ungulate species avoid. Deer, elk and moose commonly move to lower elevations to seek out areas with shallow snow and available food. The predators of these ungulates follow, leaving the subalpine forests to caribou. In summer other ungulates are more common in the high country and so are their predators; however, mountain caribou are relatively rare and spread out, which makes them infrequent prey for predators such as grizzly and black bears, wolves, cougars and wolverine.

Current Status and Trends

Historically, mountain caribou were likely distributed throughout their geographic range (within suitable habitat); however, they now occur in several relatively distinct subpopulations (Figure 1). A subpopulation is defined as a group of caribou that interact with each other but have limited interaction with other subpopulations. Eighteen subpopulations have been defined on the basis of radio telemetry data. That is, available data suggest that the home ranges of these 18 subpopulations do not overlap. However, only a proportion of any subpopulation has been tracked by radio telemetry and for periods of only a few years. And thus there is likely more interaction among subpopulations than has been observed.

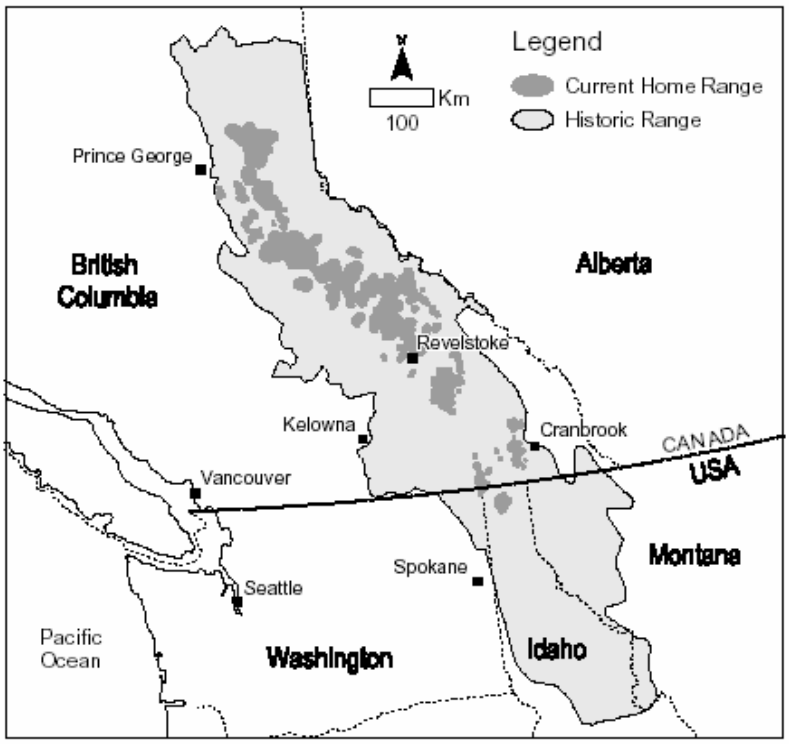

Figure 1. Historic range and current home range of mountain caribou in Canada and the United States. The historic range boundary estimates the geographic limit of mountain caribou distribution before European contact (adapted from Spalding 2000). The current home range is based on actual locations of mountain caribou collected during radio telemetry studies and aerial surveys conducted over the past 10-15 years.

Mountain caribou are one of the most well-studied wildlife species in BC, although significant gaps in our understanding of their biology remain. At a minimum, aerial surveys have been conducted on all subpopulations periodically over the past 10-15 years. Most subpopulations have also been the focus of more intensive work using radio telemetry to study movements and habitat use. These studies have also investigated the causes of mountain caribou mortalities and have estimated important population parameters. The southernmost subpopulation (South Selkirks), which ranges into Idaho and Washington, was augmented with approximately100 caribou from elsewhere in BC, after mountain caribou were federally listed as *Endangered* under the US Endangered Species Act.

From these studies biologists have quantified the current status and population trends of mountain caribou throughout their range. Broadly speaking, mountain caribou subpopulations can be stratified into four different geographic regions where ecology, population trends and threats differ:

Kootenay: Mountain caribou range south of the Trans-Canada highway. Current population is less than 150 animals.

- Mountain caribou are restricted to 4-6 fragmented subpopulations and population viability analyses suggest that the remaining subpopulations are at high risk of extirpation under current conditions[7]
- Seasonal migration to lower elevations in early winter and spring are less distinct than Columbia subpopulations
- Southern parts of the range are drier, warmer and less rugged than range farther north. Low elevation habitats have been extensively modified by human activity and are naturally fragmented by deep valleys and large lakes
- Predators include cougars, bears and wolverine but few wolves. Abundant ungulate prey include deer (both mule deer and white-tailed deer), elk and some moose

Columbia: The west slopes of the Rockies as well as the Columbia Mountains from Revelstoke north to approximately Valemount. Current population is less than 200 animals.

- Subpopulations are generally in decline and fragmenting and population viability analyses suggest that these subpopulations are at high risk of extirpation under current conditions
- Mountain caribou have distinct seasonal migrations between high elevation and low elevation habitats due to very high snowfall and rugged terrain
- Habitat is less modified by human activity than range farther south but forestry is still a significant activity, particularly at lower elevations
- Predator-prey dynamics are similar to those in the Kootenay, but increasingly include wolves and moose in northern sections

Cariboo: Includes subpopulations that range throughout the Quesnel Highland and into the Cariboo Mountains. Current population is less than 850 animals.

- Subpopulations are in decline and fragmenting and population viability analyses suggest that subpopulations are at high risk of extirpation under current conditions
- Seasonal migrations to lower elevations are limited because snow conditions at higher elevations are shallower than in other mountain caribou ranges
- Much of the range is located in large protected areas, although surrounding low elevation areas have been extensively modified by forest harvesting

- Predator-prey dynamics are dominated by a wolf-moose system

North Mountain: Includes the most northerly subpopulations of mountain caribou, located principally in the Hart Range of Rocky Mountains as far north as the Anzac River. Current population is less than 500 animals.

- Subpopulations are relatively stable
- Seasonal migration patterns are similar to Cariboo subpopulations
- Human population is relatively sparse compared to areas further south, but lower elevation areas have been extensively modified by forest harvesting
- Predator-prey dynamics are dominated by a wolf-moose system

Threats to Mountain Caribou

Threats to the current viability of mountain caribou fall into four broad categories: habitat change, predation, disturbance and climate change. These categories are not independent and are hypothesized to interact to generate the population declines observed recently throughout much of the range. Declines in mountain caribou during the late 1800's and throughout most of the 1900's were at least partly due to over-hunting[8]; however, hunting was closed completely in 1996.

Predation

Predation is the major natural cause of mortality in all ungulate populations and mountain caribou behaviour and ecology is largely based on the fundamental trade-off between the need to avoid predators and the need to acquire sufficient food.

Major declines in the population of mountain caribou began in parts of their range when moose colonized the province (or expanded from low densities) during the early 1900's, possibly due to a gradual warming of the climatic following the end of the "little ice age" of the mid-1800's[9,10]. It is believed that the presence of moose resulted in a higher wolf population, which in turn led to increased predation on caribou. Caribou disappeared from the interior plateau, but continued to survive in mountainous habitat where they could sustain spatial separation from other ungulate species[11].

In the southern part of their range, mountain caribou faced a similar situation with cougars, which increased in response to expanding deer and elk populations. In addition to possible climate change, deer and elk populations increased in relation to widespread habitat change (see below).

Grizzly and black bears, as well as wolverines, are (and probably have always been) relatively common predators of mountain caribou throughout their range[12]. Interacting with other factors that have compromised the integrity of the mountain caribou population (such as already-reduced subpopulations as a result of historic over-hunting, loss and fragmentation of range), predation stands as the most important, direct cause of the mountain caribou population decline.

Habitat Change

Threats to mountain caribou habitat include forest harvesting, fire, human settlement, roads and reservoirs. These changes can be either permanent or temporary and have both direct and indirect effects on the viability of the mountain caribou population.

Forest harvesting and fire directly remove and fragment suitable mature and old forests. These forests generally produce the dead structure most suitable for lichen establishment, on which mountain caribou rely for winter forage. Although this has a direct impact on an essential food resource for mountain caribou during a critical season, mountain caribou populations have declined faster than lichen-rich habitats have been harvested, suggesting that the availability of arboreal lichens is not currently limiting populations.

An indirect effect of forest harvesting and fire is the creation of young forest and edge habitat suitable for other ungulate species, such as deer, elk and moose[13]. Forest openings created by harvest activities are quickly colonized by browse (edible plants and shrubs), which attracts deer, elk and moose to areas that were

previously unsuitable for feeding by these species. Remaining forested areas provide cover in association with these newly created feeding areas. This phenomenon has had a dramatic effect on the distribution and abundance of ungulates in BC. Moose have expanded both in distribution and abundance throughout much of the province from an historical range that was centred in the Peace River region, while white-tailed deer, a recent arrival to BC, now occupy all valleys of the southern interior and are expanding northward. Elk, naturally found primarily in dry grassland habitats of southern BC, are also expanding northward.

While these expanding ungulate populations have enhanced hunting opportunities in BC, they have resulted in larger populations and wider distributions of the predators of deer, elk and moose – particularly wolves and cougars. This fundamental change in the predator-prey dynamics within and adjacent to the range of mountain caribou has been hypothesized as a major factor in the decline of mountain caribou. Although mountain caribou are not the primary prey of these predators, they are killed opportunistically when encountered by predators focussed on other species. The frequency of these kills is likely increasing because the habitat of deer, elk and moose is increasingly encroaching on the historic range of mountain caribou.

Additionally, there are other habitat changes that have likely affected mountain caribou either directly or indirectly. Barriers in valley bottoms such as human settlements, highways, railways and reservoirs have likely affected mountain caribou movements and have contributed to the fragmentation of caribou range. The proliferation of roads has had important secondary effects by creating travel corridors for predators, generating more human activity in the backcountry, including habitat alteration, hunting pressure (although now illegal, some caribou have been misidentified by hunters or poached) and displacement of caribou from preferred range.

Continuing degradation of mountain caribou habitat through forest harvesting and other activities in the backcountry are also reducing future recovery options. Many habitat changes result in permanent loss or fragmentation of range while others require many decades to recover.

Disturbance

Disturbance by human-related activities affects both short-term behaviour of caribou and longer-term habitat use. Studies have demonstrated that caribou populations in other parts of Canada and Scandinavia spend less time foraging in the presence of winter ecotourism operations; however, caribou appear to acclimate to the presence of humans as the season progresses[14].

While the short-term behavioural effects might be minimal, biologists are more concerned about longer-term consequences, such as displacement from preferred habitat caused by increasing backcountry activity and development, snowmobiling, skiing and commercial backcountry recreation and resource use.

A study of reindeer in Norway found that areas within 5 km of resorts or from roads and power lines in combination were avoided, and that maternal reindeer avoided areas up to 10 km from resorts[15]. Although data are limited, there is considerable concern regarding the effects of increasing use of snowmobiles in mountain caribou habitat[16]. The proliferation of roads in high elevation forests, improvements in the technology of snowmobiles, as well as a recent surge in the popularity of the sport, have led to extensive snowmobiling activity in some key areas of mountain caribou habitat. There are reliable but anecdotal reports that mountain caribou use of these areas has declined as snowmobiling activity has increased. A study of commercial heli-skiing activity within mountain caribou range in the West Kootenay found evidence that caribou use of areas was lower during months and years when heli-skiing activity was highest[17]. Alpine ski developments and cat-skiing in caribou habitat create very high levels of use that are also considered sufficient to displace mountain caribou. Researchers have observed caribou being displaced from range by snowmobiles, and lower use of some areas by caribou has been documented where snowmobile activity has increased in recent years[18]. Displacement might force caribou into poorer habitat, which could be associated with more abundant predators, poorer forage quality, or a higher risk of accidents.

Climate Change

The potential effects of climate change on mountain caribou habitat is difficult to predict, and depends on the complex interaction of a number of factors, including changes in seasonal temperatures and precipitation,

snowfall patterns, occurrence of wildfires, and outbreaks of forest insects and diseases. Climate change will likely alter the distribution and abundance of suitable habitat, and will also change the frequency and severity of significant snow events, which largely govern the seasonal movements of mountain caribou on the landscape.

Although there is considerable uncertainty regarding the future consequences of climate change, observations following mild winters indicate that warmer and drier conditions generally favour deer, elk and moose (by increasing over-winter survival).

Management Options

Reducing Predation

Because predation has been identified as the most important, direct threat currently facing mountain caribou, many of the possible management actions are aimed at reducing mortalities caused by predators. To be successful, predator management would be required over extensive areas both within and adjacent to mountain caribou range. Reducing predation can be approached in 3 ways:

1. Managing predators directly;
2. Managing the primary prey on which predators depend; and,
3. Managing the habitat of primary prey.

Managing predators is the most direct way to reduce predation on mountain caribou. Principle predators include bears (grizzly and black), cougar, wolf and wolverine. Cougars are generally considered the most significant predator in the southernmost subpopulations, while wolves are most significant in the north. Grizzly and black bears are effective predators on mountain caribou throughout their range[19]. Predation by wolverines is relatively rare.

While predator management appears to be a straightforward solution to halting subpopulation declines, there are several difficulties with the strategy. First, predator management using hunting regulations might be insufficient to kill the number of predators necessary to recover mountain caribou subpopulations[20]. Second, in the absence of other measures to recover mountain caribou, especially habitat management, predator management would need to be extensive and permanent. As a result, more extensive and socially sensitive measures, such as broad-scale kill programs, might be required. Third, reducing predators alone would likely result in even higher primary prey numbers, and if predator management was to end (for political or logistical reasons), the larger prey populations might support even higher numbers of predators, and/or unstable dynamics in the local predator-prey system.

Another way to manage predators is to manage the primary prey on which the predators largely subsist. Mountain caribou are too rare to be the primary prey of predators (although there is some evidence that some cougars have become mountain caribou specialists). Rather, cougars focus primarily on deer and elk, wolves on moose, and bears on a variety of foods. These predators will kill mountain caribou opportunistically when they are encountered; however, it is the abundance and distribution of the primary prey that ultimately determine the distribution and abundance of predators. Presumably, maintaining low deer, elk and moose populations (through hunting) will result in low predator populations, just as expanding ungulate populations resulted in higher predator numbers. However, reducing primary prey without simultaneously reducing predators might result in short-term increases in mountain caribou mortality because predators will likely range farther in search of prey and encounter mountain caribou more frequently.

The third method to manage predators is to create habitat conditions that are unsuitable for deer, elk and moose, particularly in, and adjacent to, mountain caribou habitat. This is accomplished by allowing early seral forests to grow older or by using silviculture techniques to reduce shrub cover and other deciduous vegetation that is naturally more abundant in young forests. Large, contiguous patches of older forest will remove the association of suitable forage and cover that is favoured by deer, elk and moose. This is expected to lead to fewer primary prey and, hence, fewer predators in mountain caribou range. While this management

action is most likely to lead to stable-to-increasing and self-sustaining subpopulations of mountain caribou, it may require up to 60 years for young forests to reach a sufficient age to deter deer, elk and moose and to re-establish spatial separation between mountain caribou and predators. Many mountain caribou subpopulations may become extirpated within this time frame and, therefore, any recovery actions that are expected to lead towards self-sustaining mountain caribou populations must consider predator management, at least in the short term.

There is considerable uncertainty in the expected response of different predators or groups of predators to attempts to reduce their populations or those of their prey. The dynamics of multiple predator-multiple prey systems are very complex. As mentioned above, a decline in prey might cause some predators to switch to mountain caribou, or to encounter mountain caribou more often as they range more widely in search of prey. Some researchers argue that prey populations should be expanded in order to "swamp" predators with primary prey and reduce incidental predation on mountain caribou. In addition, predators interact with each other; bears are known to drive cougars off kills, perhaps leading to higher predation rates by cougars. Decisions regarding predator-prey management will need to be made in the context of multiple uncertainties and monitored closely to determine responses.

Maintaining and Improving Habitat

Protection of current mountain caribou habitat (especially large patches of old forest) would reduce the need to recover areas in the future and would also provide additional recovery options.

In addition to the reductions in predation that are expected to occur if habitat currently fragmented by young forests is managed to include more mature and old forest, there are also more direct benefits of recovering suitable habitat. First, mountain caribou feed extensively on arboreal lichens in winter and these lichens are most abundant in mature and old forests. Although biologists believe that mountain caribou are not limited by food at their current population size, the abundance and distribution of suitable forage will play an important role in the recovery of some mountain caribou subpopulations.

Restoring habitat would also reduce threats associated with human activity in mountain caribou range, particularly if roads were closed and rehabilitated (to discourage, for example, snowmobiling in mountain caribou habitat). Restoring habitat to a state that would improve the likelihood of achieving mountain caribou population recovery would take several decades and in itself may not be sufficient to recover subpopulations. Again, some kind of predator management, at least in the short-term, will likely be required.

Reducing Disturbance

Disturbance associated with commercial backcountry recreation is probably the easiest to manage because regulations and guidelines can be developed and included as legal requirements in management plans; however, to be effective these measures need to be monitored and enforced. Activity by individuals on Crown land is more difficult to control. Voluntary guidelines can be implemented by clubs and societies or, in critical areas, access restrictions can be considered.

Compared to predation and the direct and indirect effects of habitat change, current levels of disturbance are considered a less significant (although additive) threat to the viability of mountain caribou.

Supplementing Subpopulations

Transplanting animals from healthy subpopulations, temporarily penning females and calves for protection from predators, or captive rearing are strategies usually considered as a last resort to save gravely endangered wildlife populations. Supplementing populations can forestall extirpation, but must be complimented with other actions to address the underlying causes of the population decline.

Transplanted animals might suffer higher mortality rates than residents[21], and often wander outside suitable range, particularly in the weeks and months following release. Northern ecotype woodland caribou and some mountain caribou were transplanted to the South Selkirks subpopulation over several years during the late 1980's and 1990's. There is evidence that these northern woodland caribou were able to "learn" the habitat-use characteristics of mountain caribou. Augmenting the herd with more than 100 animals over 11 years

increased the size of the South Selkirk subpopulation from 25 to more than 50 animals. Other caribou transplants have required fewer animals to achieve population increases. There are subpopulations that are now so gravely in danger of extirpation that there is little chance that they will recover unless they are supplemented.

"Maternity pens" have been used with significant success in the Yukon to protect cows and newborn calves from predators for short periods after calving.

Captive rearing has not been attempted with mountain caribou.

Probability of Recovery Success under Different Scenarios

Work to determine the probability of recovery under different management scenarios is currently underway. This process involves the development of a model that estimates the likelihood of mountain caribou recovery in relation to the various factors and threats outlined above. The model will be used to forecast the effects of different management scenarios in order to provide recommendations for recovery based on the best-available information. The model will be tested with available data and results will be reviewed by qualified scientists. The predictive power of the model will be limited by our understanding of the system and our ability to predict future conditions.

Much work remains to be completed, but some general conclusions can be drawn:

- Status quo management will lead to a continuing decline in the population. Without altering the principle threats associated with the ongoing decline of mountain caribou, subpopulations will continue to get smaller and ranges will continue to retreat, although not necessarily at the rate observed over the past 10 years. Rates of decline might accelerate as sub-populations get smaller, although some sub-populations might persist at very low levels for many years.
- Probability of success of recovery will vary throughout the range. Threats to mountain caribou subpopulations and their habitat vary throughout the range, and as a result, the likelihood of recovery will also vary. For example, southern populations are smaller and are persisting in a range that is under greater pressure from human activities than habitat further north. In addition, they are threatened by a more diverse and complex predator-prey system. The effort required for successful recovery might be higher in the south than elsewhere where these threats are not as severe. The Cariboo subpopulations might also be more difficult to recover because there is limited separation between mountain caribou habitat and that of predators and primary prey. This is primarily a function of terrain and is not easily addressed through management actions. Other factors such as climate change might work against recovery efforts throughout the range.
- Recovery is unlikely without increasing the survival of adult females and calves. Sub-populations that are in decline are plagued by lower-than-average adult female and calf survival rates. Increasing survival, most likely by reducing predation over the coming years (and perhaps decades) is essential to population recovery. Reducing predation will likely require changes in habitat management (e.g., allowing young forests to age in some areas while reducing forest harvesting in others), reduction in primary prey populations in, and adjacent to, mountain caribou habitat, as well as direct reductions in predator populations.
- Recovery will take many decades and will require a mix of management actions. No single factor has been responsible for the decline of mountain caribou and, consequently, no single management action will be sufficient to ensure their recovery. A mix of management actions will be required over the long-term, although emphasis on different actions may be required at different times and in different parts of the range.

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