

On the Management of Mountain Goats

In managing mountain goats a view to history is not amiss.

It would astonish anyone familiar with wildlife conservation in North America today to be told that the most abundant big game animal in the Rockies, shortly after the turn of the 20th century, that is a mere 100 years ago, was none other than the mountain goat. Such was the finding of a Canadian federal commission in 1916. This finding is supported by none other than the internationally renowned first Provincial Game Warden of the province of British Columbia, A. Bryon Williams in his 1925 book *Game Trails in British Columbia*. According to him, mountain goats were not only abundant, but also more widespread throughout the province than any big game animal, excepting the black bear. Williams noted that the goats had a high rate of twinning, and that even triplets had been recorded. Moreover mountain goats had gone from great scarcity, to great abundance in only 40 years.

What caused mountain goats to multiply and expand their range?

The federal commission noted that mountain goats had escaped the decimation suffered by bighorn sheep and elk. Prior to 1916 there had been no effective conservation of wildlife, which was slaughtered mercilessly by market hunters, subsistence hunters, natives and sport-hunters. By 1916, elk in Alberta had been exterminated, with the possible exception of as few heads left along the Brazeau River. Big game had been so decimated, that a superintendent from Banff National Park imported moose from Ontario for the viewing pleasure of park visitors! Elk were shortly thereafter imported into Banff National Park from Yellowstone, forming the nucleus of recovery along with a few elk that survived the slaughter in the neighboring Kootenays, in British Columbia. Williams also confirms the decimation of bighorn sheep, elk and mule deer, as well as of elk reintroductions in British Columbia. So does C. Gordon Hewitt in his 1921 book *The Conservation of the Wild Life of Canada*. Natives even boasted with their prowess as hunters, claiming that they cleared out every valley of wildlife! This was confirmed by way of mouth by Andy Russell, well known Canadian writer, who had been told of it by his father in law, the famous sheep guide and naturalist Bert Riggall, who live in southwestern Alberta close to what became Waterton Lakes National Park. Trains of pack horses came out of the mountains then loaded with dried meat and dried hides of all wildlife hunted by natives. Only one valley, so Andy

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relayed, was avoided, which, consequently, was filled with wildlife. It was a valley into which a tribe withdrew in panic during a small pox outbreak. Unfortunately, the small pox followed and the dead and dying were preyed on by grizzly bears. I was furthermore told those in charge of Alberta's forest effectively closed down such hunting by putting a tax on pack horses.

There are other hints that wildlife was severely depleted in the Rockies in the early decades of the 20th century. Bert Riggall was an excellent observer and writer. His bighorn hunts were characterized by great effort, sparse sightings, small groups of sheep, as well as rams of rather large body and horn mass. That suggests sheep living on abundant high quality forage, as is expected in population's way below the carrying capacity of the habitat.

Clearly, prior to WW I the Rockies suffered from unbelievable wildlife destruction. Mountain goats, however, were exempt. Williams reports that the lore was that they were inedible, which on occasions they are. I can vouch for that. They were thus relatively free of pursuit by market and subsistence hunters.

The above suggests that when bighorns, elk and mule deer numbers were down, those of mountain goats were up. Conversely, with the recovery of elk, bighorn and mule deer populations, mountain goat populations should decline. They did. The explanation appears to be that bighorn sheep, elk and mule deer populations remove the bulk of the forage mountain goats depend on. The mountain goat's domain, the cliffs and barrens above timberline, have little vegetation. Most feed is concentrated on fertile grassy slopes below and between the cliffs, and mountain goats exploit these rich grassy areas mostly within some 150 yards of the cliffs. However, that's exactly where mountain sheep, elk and mule deer like to feed, in the case of bighorns and elk, year round. Consequently, they deprive mountain goats of the rich forage on the grassy slopes below and between the cliffs. In addition, mountain sheep, but not elk or deer, also exploit the forage growing in the cliffs. That disadvantages mountain goats even more. In the presence of numerous mountain sheep and elk, mountain goats still have access to a vast landscape. However, the picturesque cliffs and barrens contain little feed for mountain goats. And with the rich forage below and between cliffs removed, mountain goats suffer from forage scarcity. Consequently, in the presence of large populations of sheep, elk, and deer mountain goats cannot form large, productive populations.

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Moreover, the above hypothesis fits closely my own field observations. For a decade after 1963 I and later my students, studied bighorn sheep on the *dry* Palliser Range of Banff National Park. Bighorn sheep and elk were then very numerous and wolves were totally absent from the park. Herds of sheep and elk fed year-round on the grassy slopes below and between the cliffs on that range. Mountain goats, however, were very scarce, too few and too scattered for systematic behavioral observations on that range.

On my Stones' sheep study area about Gladys Lake in the Spazisi, northern British Columbia, mountain goats and Stone's sheep in 1961-65 lived side by side, with goats about one third as abundant as sheep. The above hypothesis predicts that goat could thrive in the presence of sheep only, if they had an alternative food supply not fed on by sheep. And that is exactly what one finds in the Spazisi. This landscape is wetter and colder than that in Banff, and the alpine fir is quite common about timberline. Alpine fir is extensively browsed by mountain goats, but not by sheep. Moreover, mountain goats were able to dig through deeper snow than were sheep. That is, goats had access to forage that was denied to sheep. It hints that deep snow may be a limiting factor for sheep, so that there are landscapes where mountain goats will thrive, but mountain sheep will not, and it will be landscapes with high precipitation. And that also fits available facts about mountain goat distribution.

Moreover, two years of continuous, daily observations of sheep and goats living side by side revealed several relevant factors. When wolves appeared, as they did roughly every 10-14 days in winter, mountain goats at once deserted the open slopes and hastened into cliffs. Mountain sheep did not. They continued feeding on the open slopes, watching out for wolves. Ergo, the goats were much more ready to abandon good foraging areas than were sheep. It is noteworthy that few times wolves killed sheep; they intercepted such *below* the cliffs. Wolves killed no goats.

This difference in behavior was also reflected in how the two species went after a most favorite food: the mature seed heads of the cow parsnip, *Heracleum lanatum*. These grew densely in a few distinct pockets on alluvial soils along creeks over half a mile away from the normal range of both species. Stone's rams readily left the steep slopes and cliffs and freely ran along the creeks to feed on the seed heads. Mountain goats also descended along the creeks, but slowly, nervously, with many stops

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crowding upon little rock protuberances. The contrast could hardly be greater. Clearly, mountain goats are more likely to abandon good forage in favor of safety than sheep. Here is a hint that mountain goats are quite sensitive to disturbance. It's a reflection of their ability – or lack thereof - to exploiting maximally the available forage. There were not twin births among these goats. Moreover, I saw nannies closely followed by kids, and nannies equally closely followed by yearlings, but no nannies with a kid and a yearling at heel, and no independent yearlings, suggesting alternative year reproduction. The biggest Billie I shot weighed 265 pounds, a very long way from 375 pounds of the large Billy that killed a hiker in Olympic National Park. The goat population in my Spazisi Study areas was thus a marginal population, while in the park the goat population, by all accounts, was a thriving one.

More current facts fit the above picture. For instance, both Alberta and British Columbia goat managers dismissed population data gathered from *introduced* mountain goat populations, arguing that such were not representative of goat populations in their provinces. That means that all natural mountain goat populations left in these provinces are marginal populations short of forage. That happens to coincide nicely with the observations that these populations neither increase nor disperse geographically. Introduced goats do better, as exemplified by that infamous mountain goat populations introduced into Olympic National Park in Washington State. High reproduction and dispersal is tied to high food availability – and vice versa.

All this suggests that mountain goats are very sensitive to access to high quality forage. This “*access to energy factor*” is illustrated in a different fashion by mountain goats that lived under conditions of relative food abundance on Caw Ridge in Alberta, as revealed in studies by a team led by Dr. Marco Festa-Bianchet. They noted that female goat were first reproducing rather late in life, at an average of 4-5 years with some as late as seven years. That means, female goats were able to accumulate the necessary resources for reproduction only rather late in life, and could not do so in earlier years when they were smaller in body and subordinate to most females in the maternal band. Marco's team noted, correctly, a lot of within-group aggression in the maternity groups of goats. That happens to be significant. It signifies that during *normal* foraging large, dominant females quickly acquire access to the *choice* forage spots, displacing goats of smaller size and lower rank. That is, the presence of large dominant females deprives subordinates of resources for reproduction and growth, as the dominants *continually* consume the choice food on a meadow, and with their aggressive and assertive behavior

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deprive the subordinate of it, which, consequently, have to feed on forage of lower quality uncontested by dominants. Next note: when access to food becomes crucial, the dominant female then becomes *territorial*, thereby guarding the meager forage resource in steep cliffs. That forces subordinate goats, large males included, into pockets of deep snow. However, such are the preferred habitat of alpine firs, dwarf willows, dwarf birch and riparian vegetation. Large males can handle that; small-bodied subordinates may succumb due to hard work and lack of access to forage. Moreover, shortages of forage for *territorial* females, a sign of marginal populations, precludes the birth of twins or regular, annual births. Even on Caw Ridge about a quarter of the reproductive nannies skipped a year of reproduction. Consequently, where female goat become territorial, do not expect high reproduction or range extensions. Where forage is abundant, expect multiple births, high survival of kids, little or no territoriality by nannies, and ready geographic extension by the goat population. Whatever deprives female mountain goats of full feed, be it hard winters, or displacement by dominant females, or competition with mountain sheep and/or elk for the very same forage close to goat escape terrain, or whatever alienates the female from good forage spots be it predators or humans, all these and other factors, will insure a small mountain goat population at best, one that may – or may not - survive the added mortality of hunting.

At first glance it would appear that removing a dominant female should benefit all other goats, especially females, as it frees the forage formerly consumed by that dominant for re-distribution to others. However, that is an idle hope as was shown by Lon Kuck an observant biologist from Idaho. He noted that upon the death of a dominant, a subordinate female slips into the vacant territory, and by virtue of this is able to reproduce, at the same rate as the dominant female which was removed. There is, consequently, no increase in reproduction by all females. Compensatory reproduction in response to hunting, as demonstrated for some mountain sheep populations, is for mountain goats an illusion.

I emphasize here first the importance of high quality forage, for even such is very inefficiently converted to metabolizable energy, which in turn is very inefficiently converted to work or to fat. A hundred calories of forage such as ingested by mountain goats will give at the most eight calories of work or about two grams of body fat. And when the mountain goat escapes upward into the cliffs in its “gorgeous landscape”, the cost of hurling the body upward is some 13 times more costly than hurling it along the horizontal. Even running is less expensive in energy than climbing. A course in scientific

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livestock husbandry, such as given in the agricultural field of Animal Science, would drive this point home. It also illustrates how much levels of energy availability during body growth and development affect body size and proportions. Unfortunately, a good comparison of weights and measurements of mountain goats from different populations is not available.

The increase in mountain goats at the turn of the 20th century was, however, not only a matter of uncontested habitat by elk and sheep. There was more to it. As noted earlier, it was a time of uncontrolled market-, subsistence- and sports hunting which led to the near extinction of elk, moose, bighorns and deer, and thus to a severe scarcity of big game animals. However, the scarcity of big game animals meant also meant a scarcity of carnivores. Furthermore, the great emphasis then on ranching, sheep ranching especially, and the carnage caused there by coyotes, led to increases trapping and hunting of all carnivores. It was a time of liberal bounties placed on the heads of wolves and coyotes, but also a time when professional trappers flourished. In addition, subsistence trapping was highly developed. Here poor men trying to make a grubstake from back-breaking work had little use for carnivores, especially wolves and bears. Winter transportation in the back country depended on dog sleds. However, sled dogs and wolves do not go together, as discussed by Peter Freuchen for Greenland. Moreover, wolves had the additional habit of following trap lines destroying the precious fur trapped. Also, they were putting scarce big game animals to flight, leaving empty landscapes for some very hungry trappers and their dog teams. Bears had the nasty habit of raiding caches of stored winter meat. That was not tolerated. We know that native people then were expert at keeping wolves down, by killing pups at dens or expertly snaring wolf packs. In short, not only agricultural areas used for livestock raising, but also wilderness areas were very likely depleted of large predators. That explains in part the low bounty kills in BC, compared to later times. The scarcity of predators would have greatly benefited mountain goats, for they are not immune from severe predation losses, as research on Caw Ridge confirmed.

This glance into history suggests, ironically, that our successes in modern wildlife management restoring ungulate populations and conserving predators were both to the detriment of mountain goats. In addition, there are modern factors that spook mountain goats away from good landscapes or lead to increased killing, such as unending disturbances by helicopters flying along mountain sides helping exploration or logging crews or ferrying re-creationists into high mountains. “Resource” roads in

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British Columbia leading to goat country, in combination with general open seasons on goats, led to the extinction of goat populations. These were populations once thought untouchable. Mountain goats frightened into the most rugged and unproductive of escape terrain can hardly be expected to generate thriving, expanding populations.

Managers tried to expand goat populations by re-introducing, of which most succeeded in establishing small populations. A number failed. There is little point liberating mountain goats on ridges heavily used by mountain sheep, elk or even mule deer, especially when predators are abundant. However, the primary reason for failed mountain goat introductions has nothing to do with competitors or predators, but hinges on a misunderstanding of animal behavior. In all introductions managers selected *adults* caught on one range and liberated such on another. This, a vacant range, was *strange* to the goats. Adult animals have locked in habits of range use, partially acquired by following elders, partially acquired by their own exploration. Now, a mountain goat, liberated on a strange range, needs to get over the initial shock of capture and transport and the total unfamiliarity of its surroundings. It will stay and feed and try to live as best it can, but upon a modicum of recovery, it will strike out, *searching for "home"*. A radio-collared goat relocated in Idaho wandered incessantly, visiting 15 different goat populations, so reported my colleague Dale Toweill. What "strangeness" means I saw first-hand observing Stone's sheep. Newly arrived Stone's sheep got lost in cliffs again and again. Such sheep could not protect themselves from predators! It suggests that the inhabitants of cliff faces better know the escape routes, but also where to feed. The fact that so many introduced goats failed to thrive, failed to reproduce or simply vanished is an expected consequence of liberating adults in *strange* landscapes (also found in introduced elk¹). Some introductions are, of course, a great success such as in the Olympic Mountains. But then, these represented a vast area of superlative mountain goat habitat, supportive of goats no matter where they turned. A much more certain way to reintroduce mountain goats would be via a method pioneered by Tom Bergerud with caribou. It is to take hand-raised youngsters, lead them through the range one expects them to re-colonize, then add freshly caught wild youngsters to them in fall. The latter will follow the former, but will be better at selecting good feeding sits and, most important, having some experience in avoiding predators. These have to be controlled anyway prior to such a release.

Mountain goats to succeed need knowledge of their home range. We overlook just how precarious is

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the searching for food by mountain goats during winter and spring. The term *winter range* is an over simplification. Observe what a mountain goat does between Christmas and Eastern, between nannies driving off rutting males from their winter territory, to final descend onto sun-exposed slopes that are greening up, from the search for forage after heavy snowfalls, or the desperate and dangerous trips across steep, hard snow slopes after over-grazing their cliff-bound territory in mid winter to reach wind exposed ridges where there is at least a little food. However, there is also a brief return to the cliffs of the territory when the first green sprouts, as they sprout first in sun-exposed cliffs. Note the acrobatics in reaching the last vestiges of food in a cliff, or note the withdrawal into caves during star-spangled Arctic nights when its 50 below or worse. And note the rush to safety as avalanches and rock slides howl down the mountains. Moreover, each population lives under different circumstances, so that each marginal population is marginal for reasons of its own.

Clearly, the challenge is how to maximize reproduction in goat populations, so as to reduce the age at first births, a sign that more forage has become available. However today, the real challenge is how to reduce the hunting mortality of female goats so as to increasing their life expectancy and reproduction. Research in Alaska has shown just how difficult it is keeping hunters from killing nannies, as well as how detrimental it is killing large, reproducing nannies. The difficulty of distinguishing Billies from nannies is real, as I can vouch for. In marginal coastal Alaska populations, nannies may not reproduce till they are five to seven years old. Solutions proposed by Alberta biologists, excellent as long as the hunter confronts vigorous goat populations, would make it *illegal* to kill goats from groups of four goats or larger, or kill a kid-leading goat or kill any goat in a group of goats accompanied by kids. This will, of course, not work in marginal populations with dispersed goats living in small groups, having slow body growth. Here many nannies below six years of age will be without kids. An nice idea being tested in Alaska to force resident hunters into greater care and selectivity is to allow them to keep a nanny they shot, but disallow them further goat hunting for five years in that particular unite. Restricting hunters to taking one goat in a lifetime is an inducement to learning how to tell male and female goats apart. All jurisdictions have produced fine illustrations and descriptions of how to tell apart males from females. However, this may be love's labor lost unless hunters pass a *mandatory* test differentiating male from female goats before being issued a license or tag. That will insure no more than hunters actually looking at the teaching material. It's a step in the right direction. Still, in Idaho education has been effective in reducing the proportion of female goats killed. So, all is not lost. Note,

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however, that Utah, in order to *control* increasing mountain goat populations, “nannies-only” hunting-seasons was put in place.

Here is another example showing the importance of historical knowledge. The geographic distribution of mountain goats in modern times ends in the south in Oregon. Is this a *natural* or *artificial* boundary? The correct answer is: *artificial*. When humans arrived in North America some 15,000 years ago, mountain goats ranged south into the Grand Canyon and Northern Mexico. Those were the *natural* southern boundaries. Subsequently the highly competent hunters, beginning with the Clovis culture (11,500-11,000 uncalibrated radiocarbon years) most likely exterminated mountain goats along with other North American native species such as the Shasta ground sloths or Colombian mammoth. The last date for the southern mountain goat of 11,160+-125 uncalibrated radiocarbon years fits into the beginning of the Clovis culture. Following it and the Younger Dryas cold spell that terminated most of North America's mega-fauna, life for humans in the American southwest was harsh, and an inducement to kill everything edible. That left a lot of - *artificially* - empty mountain goat habitat between Oregon and Mexico. Unfortunately, the very low probability of preservation of mountain goat remains does not allow one to be definitive, how widely mountain goats were distributed before humans set foot in North America. Still, many populations of mountain goats have been *re-introduced* to the vast geographic space between Oregon and Mexico in Wyoming, Idaho, Utah, Nevada, Colorado, South Dakota etc. As one would expect, these goats are thriving! After all, it's most likely a home-coming to their old *native* home from which they were exterminated by man. Now note the policy adopted by the national park administration in Colorado's Rocky Mountain National Park. Goats were introduced to Mt. Evans in Colorado. These goats have wandered into Rocky Mountain National Park where authorities kill them off as *non-native*.

Do we have here a case of mountain goats being exterminated by humans, being returned by humans and being re-exterminated by humans?

It appears so. The sparse remains suggest that southern mountain goats were small-bodied, though not all, as one skull matched exactly the dimensions of a skull of an old male from northern British Columbia. The 30% differences in body size between some southern and northern mountain goats are taxonomically meaningless, as far greater differences exist regionally within the same sub-species of

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red deer, for instance. The stronger mandible however may be significant, as they speak of a higher work-load compared to northern mountain goats. And that difference could be a strictly environmental difference. DNA analysis, however, suggests fairly strong genetic divergence of northern and extinct southern mountain goats. In short, mountain goats adapted to hot southern desert conditions differed from mountain goats living thousands of miles away in the proximity of northern Alpine glaciers. One has the same phenomenon in bighorn sheep. Both species tracked genetically environmental differences. I consequently suspect the southern and northern mountain goats – genetic differences to the contrary – were no more different species than are desert bighorns and rocky mountain bighorns. Moreover, Colorado's high mountains are home to the *northern* form of bighorn sheep, and the *northern* form of the mule deer, and the *cold-adapted* yellow-bellied marmot, so that one can rightly suspect that the mountain goats existing in Colorado before human arrival in North America were likewise northerners. So, is the national park service exterminating once again a returned native species? Never mind, mountain goat would probably not thrive anyway, given the populations of bighorns and elk in the park.

A review of provincial and territorial goat management plans indicates that there is a larger amount of good will and sincere effort to safeguard mountain goats. However, there are gaps in scholarship, such as a lack of attention to history, and a poor understanding of behavior or physiology. However, all in all, it shows that management agencies are not indifferent, but very much concerned with the fate of their wards. The problem here is not bringing the horse to water, but how to make it drink. Clearly, it's up to hunters to do their part for mountain goats.

i Keller, Barbara J. et al. A review of vital rates and cause-specific mortality of elk *Cervus elaphus* populations in eastern North America. *Mammal Review*. Article first published online: 26 JUN 2015

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Juvenile survival and adult fecundity were lower in recently restored populations ($\hat{S}=0.65$, SE = 0.09; 0.62 juveniles per female per year) than in established populations ($\hat{S}=0.83$, SE = 0.07; 0.80 juveniles per female per year) in eastern North America.