

THE AMERICAN MOUNTAIN GOAT

Ace of Alpinists

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NATIONAL ELK REFUGE

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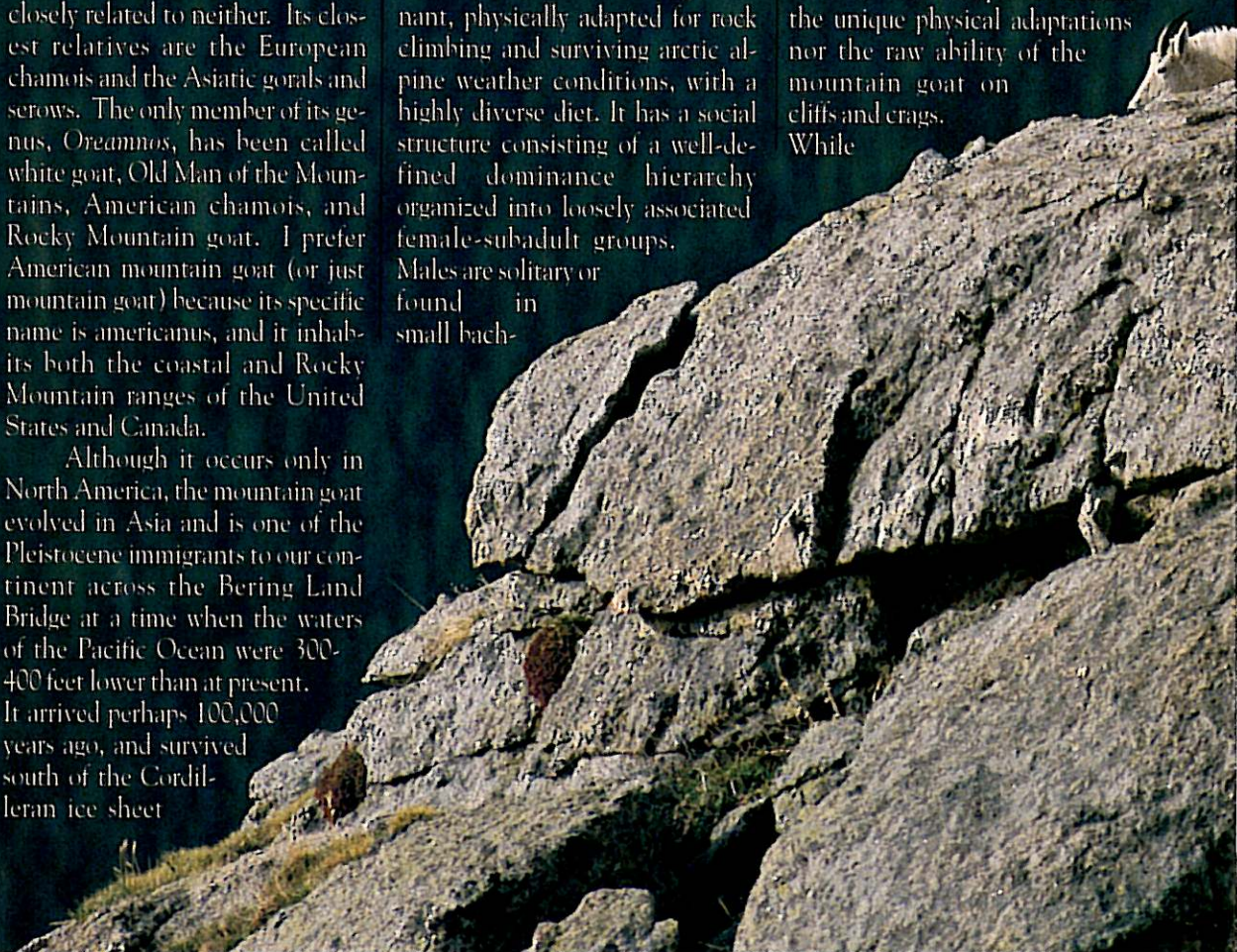
IT wasn't until February 9, 1811, at the present location of Kootenay Park in Canada, that the first white man saw the American goat-antelope with characteristics of both, yet closely related to neither. Its closest relatives are the European chamois and the Asiatic gorals and serows. The only member of its genus, *Oreamnos*, has been called white goat, Old Man of the Mountains, American chamois, and Rocky Mountain goat. I prefer American mountain goat (or just mountain goat) because its specific name is *americanus*, and it inhabits both the coastal and Rocky Mountain ranges of the United States and Canada.

Although it occurs only in North America, the mountain goat evolved in Asia and is one of the Pleistocene immigrants to our continent across the Bering Land Bridge at a time when the waters of the Pacific Ocean were 300-400 feet lower than at present. It arrived perhaps 100,000 years ago, and survived south of the Cordilleran ice sheet

at the peak of the massive Wisconsin glaciation. Fossils of its ancestors have been found as far south as California and Nevada.

By definition, the mountain goat is a mountain dwelling ruminant, physically adapted for rock climbing and surviving arctic alpine weather conditions, with a highly diverse diet. It has a social structure consisting of a well-defined dominance hierarchy organized into loosely associated female-subadult groups. Males are solitary or found in small bach-

elor groups during much of the year. Without question, the mountain goat is the ace of alpinists. North American sheep, although agile in the mountains by ungulate (hoofed animal) standards, possess neither the unique physical adaptations nor the raw ability of the mountain goat on cliffs and crags. While



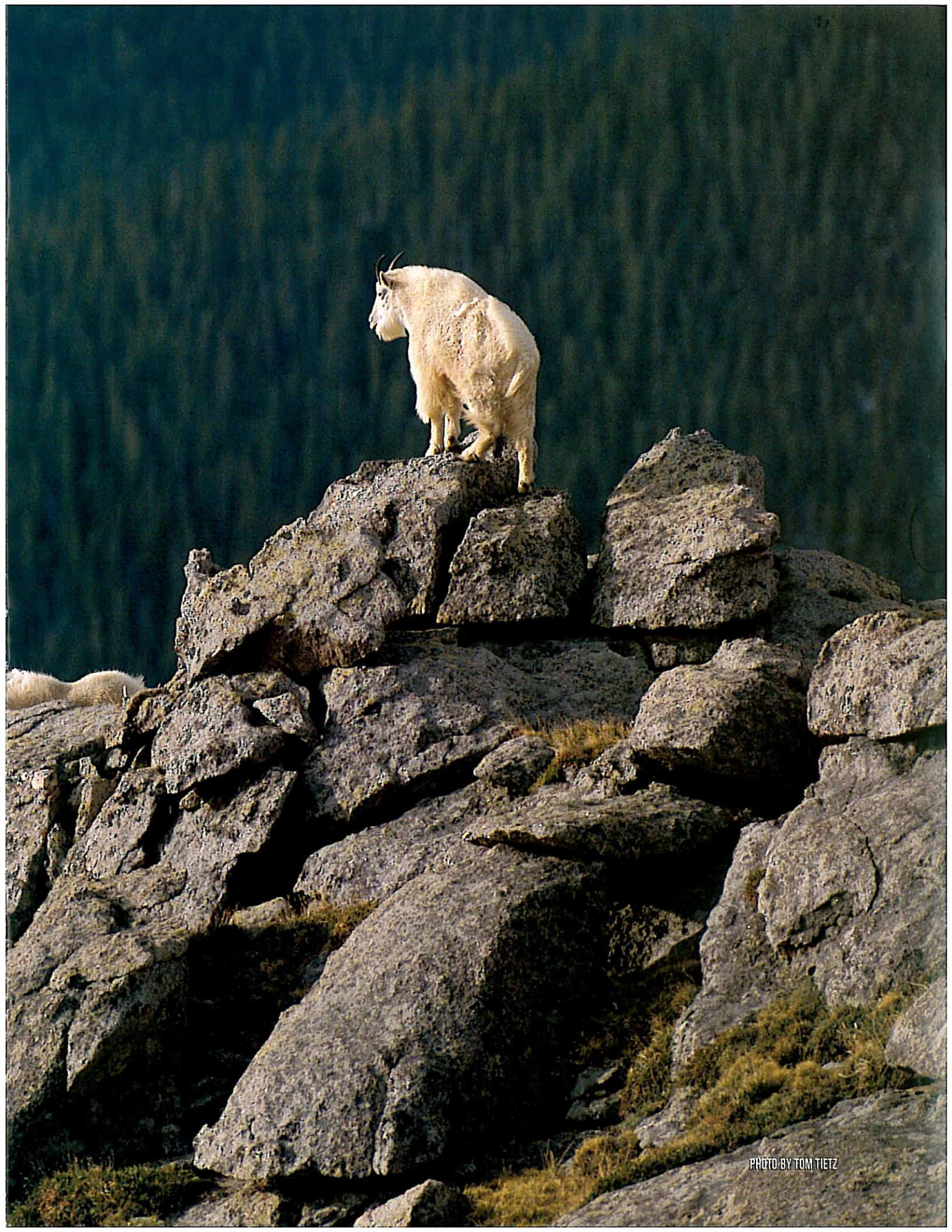



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sheep bound crisply across mountain slopes and outcrops, the goat is more of a plodder and inclined to stick to steeper terrain. Leverage, friction, and balance are the tools of his trade. The sheep are free-climbing scramblers; the goat is a technician.

Specialization begins with the hooves. Unlike mountain sheep or any other North American ungulate, the mountain goat has hooves superbly adapted to a life on the rocks. The outer portion of the hoof is a hard, bony material; but the bottom surface of the hoof is a pliable pad, convex in shape. It conforms to uneven surfaces, providing gripping ability. The four "toes" (digits two and three comprising the cloven hoof, and digits one and four being the elevated "dew claws" on the rear of the foot) are large for the goat's body size. These provide a large surface area for traction on rock and support on snow. Digits two and three of the cloven hoof are more flexible than in other ungu-

lates. As the goat descends a rocky face or steep snowfield, the toes spread apart improving balance and providing friction in an outward as well as downward direction. During descents, the goat lowers its hindquarters to reduce its center of gravity and to bring the large dew claws into contact with the substrate, increasing friction and control.

Specialized hooves are only the beginning of the mountain goat's adaptations. Its overall build includes short, stocky legs set relatively close together, and a compact torso with the forequarters decidedly larger than the hindquarters. Although it may trot or lope when startled, this is not an animal built for speed. The compact, short-legged body provides a low center of gravity, balance, and uncanny agility on narrow ledges with nothing but thin air below. The heavily muscled shoulders and forelegs help it trudge through deep snow.

I've watched a goat climb to the top of a dizzying pinnacle and stand — all four feet together

— on a summit measuring only eight inches square. Then he raised a hind foot, scratched behind an ear, and shook the dust from his coat.

Rock climbing requires a combination of strength, skill, and confidence (mental attitude). To successfully spend a ten- to twelve-year life span on cliffs requires one other ingredient: patience. Natural selection and good parental training have given mountain goats remarkable patience. Goats "choose" their routes. Their climbing is methodical, even painstaking. They are not averse to abandoning a route and seeking an alternative should the footing become treacherous. Goats are renowned for performing "walk-overs" when a cliff ledge narrows to nothingness. A quick lurch to position their forefeet against the cliff face, followed by walking the feet above the head across the face, and they're ambling back along the ledge nibbling on sedges and groundsel.

While studying mountain goats in Montana's Selway-Bitterroot Wilderness, again and again I was amazed by their patience. High on the cliffs one winter day, I stalked a nanny I wanted to immobilize with my dart gun. I planned my stalk from the canyon bottom to the ledge where she was feeding some 1,000 feet of elevation above me. An hour later, she and I met on the ledge. Startled, she ran out of sight before I could get off a shot. I waited several minutes, then followed. Just beyond an angle in the cliff where the ledge ended in a 75-foot vertical drop, she stood facing me. I couldn't immobilize her there for fear she would plummet from the ledge when she lost control of her limbs. So I retreated some

50 yards and sat, dart gun ready, behind a boulder. Surely she would retrace her steps and I'd dart her as she passed by. Three hours later, with the sun sinking into Idaho, my hands and feet numb, and my patience played out, she remained at the same location. I bid her good night before descending in the twilight. The next morning I spotted her grazing near the boulder where I had waited.

Beyond its specializations for climbing, the mountain goat's most obvious adaptation is its coat. The coarse outer "guard" hairs shed wind and snow and provide the distinctive "goat-like" appearance. Longest on the lower legs, sides of the lower jaw, and along the back (where they stand erect over the shoulders), the six-to seven-inch guard hairs provide the Old Man of the Mountains with pantaloons, beard, and shoulder hump. Beneath the guard hair is an underfur of wool as luxurious as cashmere. This dense layer (goats patented the idea of layering for warmth) insulates him from subzero temperatures and winds of six-month winters. During particularly wet weather, the lee side of outcrops, overhangs, and caves offer goats refuge. Goat caves I've found in Montana's Bitterroot Range and Glacier National Park were carpeted with a decomposing layer of goat dung.

During May, June, and July, goats seem to metamorphose from shaggy beasts of winter into the close-cropped attire they sport in summer. The guard hair of the rump, pantaloons, and front of the beard are often last to shed. With a fresh half-inch of wool adorning the rest of the body, the American mountain goat looks less than elegant, if not comical, as the molt progresses.

The white coat reflects rather than absorbs solar radiation on summer days, enabling them to remain in the security of steep, exposed terrain, rather than seeking the coolness of forests below. Still,

on August afternoons, goats may retreat to the shade of cliffs or lounge on remnant snowfields to stay cool.

The ruminant digestive system of the mountain goat and other members of the cattle and deer families, with its four-chambered stomach, is highly efficient compared to the simple digestive systems of other mammals such as humans and horses. Their digestive efficiency permits mountain goats to utilize a variety of coarse

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plants in winter when the availability of nutritious green forage is limited in temperate and subarctic regions. Although a specialist in many ways, the goat is a generalist in diet. Winter fare includes grasses and sedges, shrubs, forbs, twigs of deciduous and coniferous trees, mosses, ferns (including rhizomes that are pawed from the soil), and lichens stripped from trees and nibbled from rock surfaces. The diet composition of each food item varies with location across the mountain goat's range, with snow depth, and with stage of growth or curing of each plant.

Finally, I should add a few words about the mountain goat's horns. They are black, upright, dagger-like, and are eight to eleven inches long in adults. The horns are neither spiralled (as in true goats) nor arced (as in wild sheep). They appear similar in both sexes (fact is, there is little difference in appearance between the sexes). The horns constitute formidable weapons when the head is lowered against a would-be predator. However, their primary function is associated with

dominance establishment and maintenance in the goat's social hierarchy. A high social position confers breeding rights, access to optimum feeding sites, and relative freedom from challenges by other group and herd members.

The annual cycle of the mountain goat begins with the birth of offspring during late May and early June on winter ranges. A nanny will isolate herself from other goats and produce a single snow-white kid, or rarely twins. Kids are born in particularly rugged, steep terrain, probably as an anti-predator strategy. From the moment of birth, their surroundings are seen as vertical, and this may leave a lasting impression of the way their environment should be oriented.

Newborn kids weigh just six to seven pounds, but are quite precocious. Just thirty minutes after its birth, I watched a kid scrambling to follow its mother across a fell field strewn with bathroom-sized boulders. Being born into such an environment means more than a few bumps on the chin, but predators are relatively few on the cliffs and nannies are doting mothers. When moving across steep slopes, nannies often position themselves just downslope of their kids, presumably to protect against miscues by their youngsters.

Newborns quickly gain strength. Within a week or two of birth, the spring migration to summer range begins as winter's snow recedes from the high country. Summer range offers abundant, nutritious forage (grasses, sedges, and forbs), enabling goats to recover from the previous winter, produce milk for their young, and to lay on fat for the coming winter.

Summers are short in the mountain goat's domain, and the fall migration precedes or coincides with the November breeding season. Heavy snows precipitate the return to winter range.

Fidelity to seasonal ranges — particularly winter ranges — is characteristic of goat herds. Ra-

dio-collared individuals have frequented the same section of cliffs year after year, even returning to favored bed sites. Recently introduced goats may exhibit some tendency to wander since they do not have traditional ties to seasonal ranges in their new homes. For example, mountain goats introduced to Montana's Absaroka Mountains in 1960 have colonized contiguous portions of Yellowstone National Park. Likewise, goats transplanted to Idaho's Palisades Range have been observed 20 to 44 airline miles to the north in Grand Teton National Park. This creates a dilemma for Park Service managers, because mountain goats are not native to Grand Teton and Yellowstone. Had colonizing goats originated from pioneering native populations, they would have been welcome. Instead, they are considered exotic species. Government efforts to control goats transplanted to Olympic National Park have met with limited success and significant public opposition, despite National Park Service concerns that endemic plants of the Park are threatened by feeding and dust-bathing activities of mountain goats.

Mountain goats are polygamous, but males do not gather harems. In romance too, patience is virtuous. Billies cautiously approach and sniff females to determine their reproductive status. Submissive posturing is characteristic of male advances. Females not in estrus will threaten or charge their suitors once their personal space of six to eight feet is violated.

The peak of mating occurs near Thanksgiving Day. Once mating is accomplished, males wander off to spend much of winter solitarily or in bachelor groups.

Females, their kids, and subadults (yearlings and two-year-olds) associate in small groups of changing membership. The nanny-kid bond is the only enduring union in goat society, lasting 11 to 12 months. In general, adult females with kids are at the top of the dominance hierarchy, followed

by barren females, two-year-olds, and yearlings. Dominance is established and maintained in the pecking order by ritualized displays, postures, and threats. The most intense involve horn contact, which can cause serious injury or death. Displays and avoidance therefore settle most issues of social order.

Despite the much larger size of adult males (150-200 pounds compared to about 125 pounds for adult females in the lower 48 states), billies assume a subordinate role when they encounter female-subadult groups. As a result they often occupy habitat peripheral to the rest of a herd. This reserves the best habitat and food resources for the reproductive segment of the herd and their offspring.

Mountain goats find security in steep rocky terrain and they are seldom far from it. Their evolved survival strategy includes patterned behaviors that enhance security on the cliffs. As Montana goat researcher Douglas Chadwick explained: "The normal activities of mountain goats are interspersed with behavior patterns that have developed as anti-predator devices. These include: the habit of raising the head to look around at intervals while feeding, a proclivity for walking on the outside edges of ledges and overhanging snow cornices to gain a better view of the situation below, pausing on high vantage points during feeding and traveling to gaze for long periods of time and test the wind before going on, the selection of bed sites that overlook the landscape and have a high wall behind them, a routine of carefully surveying their surroundings for several minutes before bedding down, and rising and turning every half hour or so to scan the terrain anew and then re-bedding to face a different direction than before (though this is probably for the sake of relieving stiffness too)."

As its behavior suggests, the mountain goat relies mainly on sight and smell for detection of danger. In the goat's noisy environ-

ment of wind, falling rock, cascading water, and snowslides, small noises rarely draw its attention. With a cliff at the goat's back that only it can climb, it seldom looks for danger above. Furthermore, daytime air currents generally carry upslope. Herein lies his vulnerability. Most of my successful stalks, whether for observation, photography, or immobilizing animals, were approaches from above. More often than not, this involves a climb up the cliffs out of view of the stalkee, a traverse, and then descent to the last observed location. Sometimes the fruits of this labor are warm droppings in an abandoned bed site. However, this technique often rewards the stalker.

Despite this vulnerability to approach from above, successful attack on this ledge-dweller is quite another proposition. Predation is a relatively unimportant source of mortality in most goat herds. Likewise competitors are scarce in the goat's chosen habitat. On winter ranges, mule deer are occasionally seen. Mountain sheep may occur in the same general area but prefer windblown ridges rather than cliffs. However, where mountain goats have been transplanted to ranges with limited cliffy terrain, they may compete with native sheep herds.

Mountain lions, golden eagles, and occasionally even bears and wolverines may prey upon this gentle mountaineer. The primary sources of natural mortality among goats, however, are the perils of spending winter in steep, snowbound habitats. Winter tends to weed out the weak and less fit of most species in northern latitudes. Winters are just a little longer and more treacherous if you are a mountain goat. As snow blankets winter ranges, food becomes scarce, and the goats must expend more energy to travel and paw for their next meal. Thus their catholic diet.

Prime feeding sites are on steep slopes and narrow ledges where radiant energy and gravity remove snow. Food occurs in small patches. Given the rigid organiza-

tion within goat society, it is impractical for large groups to exploit patchy food sources on cliffs. As winter progresses, snow crusts. Pawing becomes difficult. Forage becomes depleted. More calories are expended to fill the rumen. And the nutritional quality of the diet declines. If the weather does not break by early spring, malnutrition begins to affect some animals.

Kid goats enter winter weighing a mere 30 to 40 pounds—considerably smaller than young of any of our other northern latitude ungulates. At this size, the surface to volume ratio (and therefore heat loss) is high; stamina to paw for food is limited; and legs are too short to move efficiently through deep snow. Kids are dependent on their mothers to break trail; to paw feeding craters; to provide protection from larger, more dominant goats; and for some measure of body heat and wind protection when bedded. Still sur-

vival can be problematic when you're 35 pounds and winter lasts six months. Annual winter mortality among kids ranges from 30 percent to 60 percent in studied goat herds. The more severe the winter, the higher the death rate.

Yearlings fare only slightly better. At only half of adult size, and no longer enjoying the social rank of a protective mother, they must remain alert to aggression from all other members of female-subadult groups. During one winter

in Montana's Selway-Bitterroot Wilderness, over-winter mortality of yearlings was 29 percent.

Once winter subsides in late March and April, the mountain goat is not over the hump. In fact, spring can be the most treacherous time of year for young and old, male and female alike. This is the season of avalanches. The sliding of snow on goat winter ranges can be an awesome spectacle when conditions are right. During the day, exposed rock absorbs solar

heat and melts adjacent snow, which flows and freezes under large snowfields. Fluctuation of temperatures around the freezing point causes slabs of snow, both small and immense, to slide off ledges, crash over cliffs, and plunge down debris chutes, carrying ice, rock, and vegetation along for the ride. This is not a good time to live on a cliff.

But the shedding of snow by the mountains is both a blessing and a curse. Avalanches expose

HUNTING REGULATIONS FOR ROCKY MOUNTAIN GOATS

| State/Province | Hunting Permits in 1996 | Range of Permits since 1986 | Goat Age Restrictions | Goat Sex Restrictions | Application Limitations | Harvest Criteria |
|------------------|-------------------------|-----------------------------|-------------------------------|--|--|--|
| Alaska | 662 ^A | 452-662 ^A | None | Encourage taking males | None | 2-10% of observed goats ^D |
| Colorado | 112 | 82-120 | Encourage taking mature goats | None | 5-year wait to reapply if you harvest a goat | 5-8% of population |
| Idaho | 59 | 64 | None | Nannies with kids are protected | Can harvest only one goat in lifetime | Less than 5% of non-kid goats ^C |
| Montana | 263 | 260-330 | None | Encourage taking males | 7-year wait to draw again | None ^D |
| Oregon | 2 | ^E | None | Encourage taking adult males | Can draw only one permit in lifetime | None |
| S. Dakota | 5 | 4-5 | None | Encourage taking adult males | Can draw only one permit in lifetime | Less than 5% of known population |
| Utah | 20 | 10-20 | None | Encourage taking adult males | Can draw only one permit in lifetime | None ^D |
| Washington | 106 | 106-325 | Minimum 4" horn length | Encourage not taking nannies with kids | None, preference points awarded | Less than 4% of known population |
| Wyoming | 12 | 8-12 | None | Encourage taking adult males | 5-year wait to draw again | None |
| Alberta | 0 ^F | 0-35 | Not Applicable | Not Applicable | Not Applicable | Not Applicable |
| British Columbia | 3,268 ^G | 2,024-3,268 ^G | None | Encourage taking adult males | None | 2-5% of estimated population |
| N.W. Territories | ^H | ^H | None | None | None | None |
| Yukon | 3 ^I | 3 ^I | Kids are protected | Nannies with kids are protected | None | None |

^A Alaska offers three types of goat permits: drawing permits (numbers shown in this column, drawn by lottery); registration permits, which can be obtained directly at specified vendors and have ranged from 1,882-2,237 in recent years; and limited numbers of tier II permits for subsistence hunting, which have ranged from 46-105 in recent years.
^B Varies with productivity of individual herds.
^C Also up to 5% of non-kid goats can be harvested if twinning rate exceeds 50% of females; and only herds with at least 50 goats are subject to harvest.
^D Varies with population productivity.
^E Goats only previously hunted during 1965-1968.
^F Mountain goat season has been closed since 1987.
^G British Columbia offers limited entry permits (numbers shown in this column), and general open season permits (no limitations on permit numbers) in the northern third of the province.
^H No restrictions on permit numbers but very little interest in goat hunting in Northwest Territories.
^I The Yukon offers limited entry permits (numbers shown in this column), and general open season permits (57-95 issued annually during past 10 years) for very inaccessible areas.



new patches of food to winter-weary goats. But they are also the single greatest cause of goat mortality. Many researchers have found the crumpled remains of goats in avalanche debris in spring. The carcasses serve as carrion for bears, coyotes, ravens, and other scavengers.

Thus, the Old Man of the Mountain pays a price for his security in the cliffs. The hoary marmot, the mammal with which the mountain goat's distribution most closely coincides, avoids the perils of winter by hibernating from October to June. Far beneath winter's white blanket, it lives off stored fat manufactured from last summer's crop of glacier lilies and sheep fescue. It never hears the avalanches that thunder down the mountains as it hunkers against the cliffs.

Despite the rigors of long winters and perilous springs, the mountain goat has roamed the North American cordilleras since his ancestors crossed the Bering Land Bridge from Asia. Today it inhabits most of his historic range. Transplants have expanded this range to the states of Colorado, Nevada, Oregon, South Dakota, and Utah.

Until midway through this century, there was so little concern for goats' welfare that only two studies had been conducted on the species. The possible misconception that mountain goats were safe from exploitation, due to the inaccessibility of their habitat and their relatively poor table fare, resulted in their neglect as a species to be "managed."

Studies in the 1970s and 1980s in Canada and the United States showed that: (1) harvest of females (either-sex harvest had been the rule in all states and provinces with huntable goat populations) may reduce productivity and recruitment in mountain goat populations; and (2) removal of goats from a population by hunting increases overall mortality, rather than substituting for other kinds of losses. This latter point requires some explanation.

For most hooved big-game species, wildlife managers recognize that a harvestable surplus exists. In place of the natural mortality that would occur, they plan to remove the annual surplus by hunting. Some animals still die in winter because hunters cannot necessarily select the old, weak, or less fit. With bighorn sheep, females, young, and subadults are subject to harvest in only the most productive populations. This is the case because of the species relatively low reproductive rate and high winter mortality. By protecting the reproductive segment of the herd, managers can provide for a harvest without reducing herd size over time.

Like bighorn, mountain goats have low reproductive rates and high natural mortality — primarily among kids and yearlings. But unlike bighorns, the sexes are not readily distinguishable in the field

without training and practice. As a result, harvests of goats were traditionally not restricted to males, and often removed nearly as many females as males. Because the mountain goat is considered a trophy species, hunters primarily kill adults, which have larger horns and bodies than subadults. Thus, harvests erode some of the reproductive potential of herds and do not compensate for natural mortality, which is concentrated in younger age classes. This factor combined with historically liberal hunting regulations, uneven distribution of harvest among individual goat herds within large hunting units, expanded road access to goat ranges, and management prescriptions based primarily on harvest trends led to declines in mountain goat populations throughout North America during this century.

Hunter success — an important ingredient in designing seasons

AN ADULT NANNY GOAT AND HER NINE-MONTH-OLD KID DURING EARLY SPRING. KIDS GENERALLY REMAIN WITH THEIR MOTHERS FOR 11 TO 12 MONTHS. FEMALE SUBADULT GROUPS ARE COMPOSED OF ADULT NANNIES, THEIR KIDS, YEARLINGS, AND TWO-YEAR OLDS OF BOTH SEXES.

Photo by author.



for plains and forest-dwelling ungulates — can be a weak and misleading indication of population trend and well-being of goats. Three particular characteristics of mountain goats account for this: (1) their rigid social hierarchy in which dominant females occupy prime habitats, (2) fidelity of herds and their offspring to seasonal ranges, and (3) the goat's reluctance to colonize new habitats. Where hunting occurs on or adjacent to winter ranges, hunters tend to frequent the most accessible areas where they have seen the most goats. These are generally habitats occupied by female-subadult groups. Males may associate with females if the rut is in progress and some hunters work to distinguish and bag a billy. However, females are inevitably harvested also, under either-sex harvest regulations. Removal of several females vacates prime habitats, which are then occupied by the next most dominant animals — other adults and two-year-old females. Those may be harvested in future years as they and the hunters return to prime goat habitats. Hunter success may remain high, but the herd is shrinking. Natural mortality continues among juveniles. With fewer females in the herd, the number of kids born each year declines. Harvest of nannies may also reduce the chances of over-winter survival of their kids. Thus wildlife managers now recognize the importance of surveying goat populations to estimate population size, trend, reproduction, and the recruitment of last year's kids into the yearling age class.

In 1996, nine states and three Canadian provinces supported huntable goat populations. Outside of British Columbia, which harbors more goats, by far, than any other province or state (about 50,000), wildlife managers either encourage or require the harvest of male goats or at least discourage the harvest of females with kids at heel. Brochures and classes

help hunters learn distinguishing characteristics of the sexes. Except in some productive, introduced herds, harvest rates are generally held to 5 percent or less of pre-season goat numbers.

Range expansion has been accomplished in recent decades solely as a result of transplants. Transplanted into suitable ranges, mountain goats can do very well and reproduce at a higher rate than native herds. This has occurred, for example, since the introduc-

of social behavior, fidelity to seasonal habitats, and the hardships of winter. The stability of populations in the U.S. and Canadian national parks suggests that populations are self-regulating, left undisturbed on historically occupied ranges. However, alterations of their habitat can upset that stability. Energy development and logging have directly or indirectly precipitated declines in remote goat herds in Alberta, Idaho, and Montana. The inaccessibility of resources in goat country has historically protected them from extraction. However, creating access adjacent to goat cliffs can be as devastating to a herd as actual loss of habitat. In more than one case, overharvest and poaching have followed after a gravel road replaced a pack trail to a herd's winter range. Roads punched along ridge tops above goat cliffs render goats particularly vulnerable.

Because of their specialized niche, mountain goats can't just "go somewhere else" when their wilderness haunts are tamed by human enterprise. "Somewhere else" will likely not be suited to their specialized lifestyle and may well subject these cliff dwellers to additional stresses in habitats to which they are not adapted. Goat ranges are unique wilderness areas inhabited by this unique wilderness beast.

After observing, photographing, and studying mountain goats during the past three decades, I'm still inspired and amazed by them. Their placid nature, superb adaption to a vertical and often inhospitable environment, doting maternal care of their young, respect of social position, and independent spirit make them a very special part of North America's wildlife heritage. In many ways, the mountain goat is a symbol of the American wilderness, and like wilderness, presents a clear challenge to us. The future of both are braided together — to conserve the animal, we must conserve the wild places it cannot do without.

I'VE watched a goat climb to the top of a dizzying pinnacle and stand - all four feet together - on a summit measuring only eight inches square. Then he raised a hind foot, scratched behind an ear, and shook the dust from his coat.



tion of 12 goats between 1969 and 1971 into the Snake River Range of eastern Idaho. By 1983, the herd had grown to 142 animals and 29 percent of the nannies produced twin offspring that year. The lesson from past introductions into unexploited habitat is that an initial boom is followed by an eventual bust. The population declines dramatically and is slow to recover — if it does. Instituting well-conceived annual harvests before a population approaches the carrying capacity of its habitat can avert this outcome. In 1983, the first hunting season was implemented in the Snake River Range to try to stem the herd's rapid growth. The herd has since been hunted annually, now numbers about 250, and also serves as transplant stock for depleted native herds in central Idaho.

Even when modestly harvested, native goat herds tend not to over-populate their range as can occur with pronghorn antelope and deer family members. Mother Nature continues to regulate herd sizes through the delicate interworkings

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