THE IMPACTS OF HUNTING ON IDAHO'S PAHSIMEROI MOUNTAIN GOAT HERD[1]

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Abstract: The ecology of the Pahsimeroi mountain goat herd, located in east central Idaho, was studied between June, 1969 and February, 1975, to ascertain the factors contributing to this herd's decline. As part of the study, the impact of hunting was measured. Goat distribution, productivity, and intensity of forage utilization were studied during the first three years when harvest levels were constant. These years were followed by three years of manipulated harvest, the intent being to harvest enough animals each year to equal the previous year's kid production. An evaluation of distribution and movement patterns of 27 marked goats (6 with collars, 21 with radios) demonstrated that adult nannies dominated the winter social structure. The dominant nannies consistently selected the same winter ranges which were steeper, having greater snow shedding characteristics, than adjacent shallower cliffs which were utilized by subordinate animals. The key factor controlling winter range selection appeared to be physical (snow shedding) characteristics of the area and not the availability of food. Dominant animals, when shot, were replaced on their winter ranges by subordinate individuals from adjacent ranges. Although basic kid production appeared to be a function of available food supplies, increased kid production and suvival did not occur with increased harvest. Food supplies available to unharvested animals were not utilized as goats tended to redistribute themselves in favor of physical terrain instead of available food supplies. Therefore, harvest mortality for this goat herd was considered additive to natural mortality and compensatory increases in goat productivity were not observed.

Without adequate research on the ecology of mountain goats, past hunting programs for this species have been justified by extending the same concepts and principles used by North American game managers to justify harvest programs for other ungulates (see Eastman, these Proceedings). These principles, which have evolved primarily from the study of deer and small game, imply that a carrying capacity exists for each species and each population tends to adjust its numbers toward this capacity. The underlying basis for this approach to game management is the concept of habitat. Both the quality and quantity of habitat are considered the primary limiting factors, with habitat often being considered the only suppressant on game populations. Ungulate managers have extended this habitat approach to winter range and the condition of winter forage as the ultimate limiting factors controlling ungulate populations.

Although habitat may be the ultimate controlling factor for the existence and maintenance of each species, the habitat approach to game management only considers one aspect of the total biology of each species (Geist 1971). The uniform application of this approach to ungulate management, although previously untested for mountain goats, is founded on the concept of intercompensation. This concept assumes that, when population numbers are low or reduced below carrying capacity through hunting, the production and survival of young tends to increase; conversely, the rate of production and survival of young declines when population numbers are high or the animals are unhunted and the population is at or above the carrying capacity of the habitat (Errington 1946).

The Pahsimeroi mountain goat herd, located in east central Idaho, has been hunted under the traditional principles of game management. Faced with a declining number of goats on the Pahsimeroi, the Idaho Department of Fish and Game initiated a mountain goat research program in June of 1969, to investigate the factors contributing to this decline (Fig. 1). The underlying objective of this study was to ascertain the causes for the population decline with particular emphasis placed on determining the intrinsic role between mountain goats and their habitat and the response of this population to standard game management practices.

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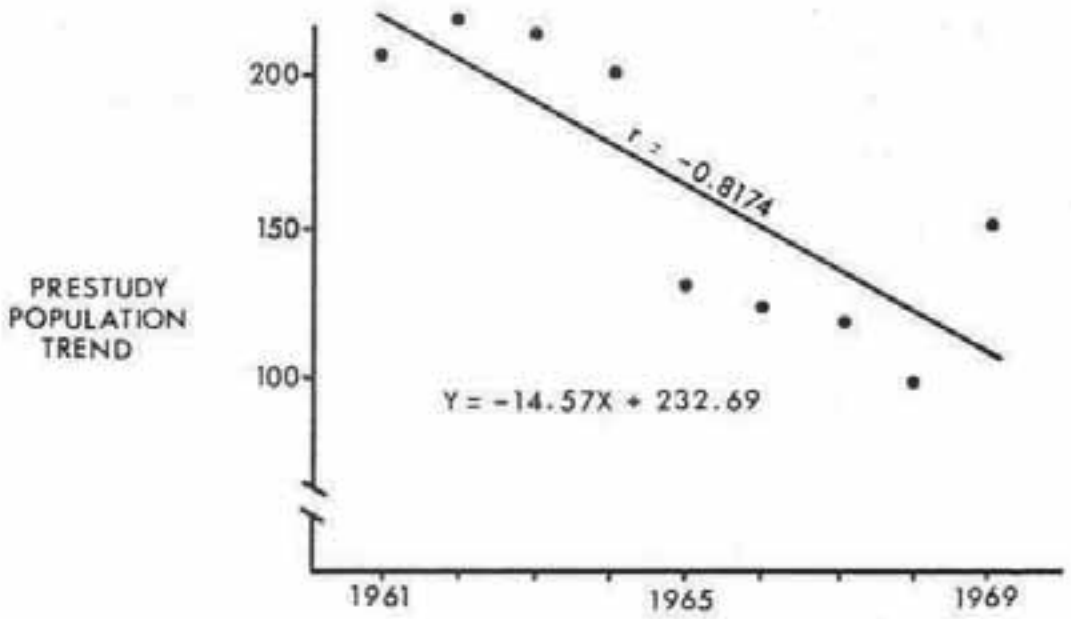

Figure 1. Prestudy population trend from 1961 to 1969 for the Pahsimeroi mountain goat herd. Data were obtained from annual winter helicopter trend counts on the study area.

STUDY AREA

The Pahsimeroi mountain goat herd, a population near the extreme southern extension of this species' natural range, occupies the Lemhi mountain range in east central Idaho. This range, remarkably long and narrow, divides two broad intermountain valleys, the Pahsimeroi and Lemhi, both major tributaries of the Salmon River. Glaciation accentuates the physiography of the Lemhi range and the trend of this range is dissected perpendicularly by a series of narrow, glacially cut canyons. Relatively recent post-glacial faulting and uplifting of this range, with associated accelerated erosion, have formed extremely rugged steep walled cliffs along the lower reaches of the Pahsimeroi and Salmon drainages. Concentrations of wintering mountain goats utilizing these broken cliffs were named the Pahsimeroil mountain goat herd by early inhabitants of the valley. Elevations of the long crest of the Lemhi range average nearly 3,048 m, the glacially cut canyons break through the range front and emerge at the valley floor between 1,829 and 1,980 m in elevation.

The vegetation on the study area reflects both the exeric condition at the valley floor, where the average annual precipitation rarely exceeds 20 cm, and the extreme topography which is in excess of 1,370 m from the valley floor to the alpine tundra found on the more mesic timberless ridges. The cold desert shrub, curl-leaf mountain mahogany (Cercocarpus ledifolius), an indicator of the dry climatic conditions on the study area, is the dominant vegetative species found on the steep southern exposed cliffs utilized by the wintering Pahsimeroi mountain goat herd (Kuck 1970). The area has been described in greater detail by Kuck (1971).

METHODS

Helicopter trend counts, initiated in 1959, were continued annually through this study in the same manner and intensity as previously established. Each winter, between January and March, a total of 12 to 15 hours of flying time was utilized to inventory all known or suspected mountain goat winter ranges on the study area, to establish minimum population numbers, trend, distribution, and productivity. Range use patterns and distribution for goats were determined through direct observation. Each animal, or group of goats that behaved as a unit, was classified as an observation. For each observation, the habitat type, elevation (by 152 m (500 f) units), aspect, percent slope, snow depth and distance from nearest known water source (including snow) were noted. Environmental conditions and individual goat activity were also recorded for each observation. Each observation was plotted on a quarter section grid map of the study area and the grid location quantitatively described for computer analysis by a numerical coordinate system to establish distribution patterns.

When time is sufficient for careful classification, the slow maturation and the differential size between age classes of mountain goats, allows for division of goats into three age classes: adult, yearling, and kid. Since the data presented in this paper are dominated by aerial classifications, to eliminate error, goats were classified only to adults or kids and yearlings were grouped with adults to reduce bias. Production was expressed as percent of kids in the total population.

Trends in winter range conditions and forage utilization were determined by the key browse survey method developed by Cole (1963). Each spring, estimates were made of the percentage of annual growth browsed from individual shrubs of curl-leaf mountain mahogany and the degree of hedging or the removal of the previous year's growth from each browse plant. Permanently marked transects, each sample unit consisting of 50 plants, were established at the base of individual winter ranges. Each transect ran vertically based upon the closest plant sample technique within 180 degrees of the next vertically closer plant. In the spring of 1970, six transects were established and evaluated annually. Each transect was placed on a major mountain goat winter concentration area with terrain which was reasonably traversable by man. Following the 1971-1972 helicopter trend count, four additional transects were established to compensate for changes in population distribution and to replace one of the original transects destroyed by insect infestation.

The surface area and steepness of slope were determined for all winter ranges. All snow shedding terrain, with mountain mahogany used by wintering mountain goats, was delineated and plotted on black and white aerial photos. These delineations were transposed onto USGS 7.5 or 15 minute topographic maps and the steepness in slope was determined in degrees of calculation of the ratio between the vertical map width of the winter range to the vertical rise, as determined by the number of contour lines traversed. The map acreages of each winter range were then converted into actual surface acres.

The Pahsimeroi mountain goat herd was intentionally manipulated through legal sport hunting programs to measure the response and impact to hunting following the 1971 hunting season. Since 1954, after a six year hunting closure on Idaho mountain goats, the Pahsimeroi goat population has been exploited under a controlled permit system. Permitees were restricted to a specific

hunt area which was allocated by a lottery system. Since initiating the intensive mountain goat harvest program on the Pahsimeroi in 1960, the Pahsimeroi and Salmon River sides of the Lemhi Mountain range were divided into four separate hunting areas to disperse hunting in proportion to available animals.

Prior to the initiation of this study in 1969, the number of allotted permits varied from 15 the initial year, up to 40 for several years and then down to 20 in 1967. The distribution and allocation of the 20 permits previously set for the 1968 season were held constant for the first two years of this study, the 1969 and 1970 harvest years. In 1971, the study area was further divided into five units with five permits being issued for a previously unhunted area. The remainder of the study area was hunted under the same intensity as previously hunted the first two years. During these three years, mountain goat productivity, habitat use, distribution and forage utilization under this constant harvest level were documented.

The practice of arbitrarily setting permit levels (20 in 1969 and 1970, 25 in 1971) was discontinued following the 1971 season to implement an increase in harvest programs on the Pahsimeroi herd. Prior to increasing the number of permits, the study area was further divided into seven hunting units then, for the 1972, 1973, and 1974 goat seasons, the number of permits issued each year was directly proportional to available goats and kids produced on the study area. Available permits for each unit were determined by multiplying the total number of goats observed by helicopter within each unit by the average hunter success for the previous three years. The intent of this permit system was to remove goats in proportion to the number of kids produced the previous year. Goat harvest was documented through direct contact with hunters in the field and through the department's voluntary report card system.

The movement patterns of the Pahsimeroi mountain goat herd were determined by trapping and tranquilizing goats from the ground or from helicopters. In the absence of natural licks, four artificial salt licks were established in 1964 for trapping sites. After establishing goat use, four and six goats were trapped with drop nets during early summer of 1971 and 1972, respectively. The 21.4 by 21.4 m net was constructed of Number 72 knotless nylon with a 15.24 cm mesh. The net was suspended 3.0 m from the ground at the corners and 4.6 m at the center. Nets were hand triggered from a blind after goats were lured under the net with the salt. The 1971 goats were marked with easily recognizable collars and ear tags. Relocation of marked animals was attempted semi-weekly from fixed-wing aircraft through June of 1972 and during the annual winter helicopter surveys. Goats trapped in 1972 were instrumented with radio transmitters (47MHz) similar in design described by Seidensticker et al. (1970). Radios were affixed to goats with a 7.6 cm wide, white neoprene impregnated nylon collar painted with black neoprene symbols for identifcation. Goat trapping was discontinued following the 1972 summer because predictable numbers of goats could not be attracted to the salt licks to justify the time and expense for this technique.

Between October, 1972, and July, 1973, 17 goats were immobilized from the ground or helicopter with intramuscular injections of etorphine hydrochloride (M99, 1mg/cc, American Cyanimid Company, Princeton, New Jersey) in three mg doses for adults and yearlings of both sexes. M99 was administered to free ranging goats with a Cap-Chur Gun and projectile syringes (Palmer Chemical and Equipment Company, Atlanta, Georgia). Fifteen of the 17 animals immobilized with M99 were tranquilized from a Bell GJ 82 helicopter. These animals were drugged in late October or late June when the animals concentrated on spur ridges above timberline. After immobilization, each animal was aged and instrumented with a radio. Recovery was induced with six mg. of the antagonist diprenorphine (M50-50, 2mg/cc, American Cyanimid Company) intramuscularly. The remaining two goats immobilized with M99 were approached on the ground while the animals were restricted to cliff winter ranges. The instrumented goats were located weekly from the air with a Cessna 182 (Seidensticker et al. 1970). Radios were first located in general areas at higher elevations; specific locations were established flying at lower elevations utilizing terrain to block out signals and attempting to pass directly over the marked animal. Each relocation was plotted on a topographical composite map of the study area. Habitat characteristics, date, time, and activity for each location were also recorded.

RESULTS AND DISCUSSION

Constant Harvest

The Pahsimeroi mountain goat herd is migratory utilizing a variety of habitat types at the higher elevations throughout the summer months (Kuck 1971). During the summer, the primary habitat type used is the open, gentle ridge tops at elevations of 2,895 m and above. These unique ridges are actually remnants of the original surface prior to faulting and glaciation of the Lemhi Range. Relatively uneroded when compared to adjacent glacial formations, the soils on these ridges provide for the ample establishment of a variety of important summer forages that are utilized by this goat herd. This herd, essentially a two-season goat herd, is sensitive to major snow accumulations. They remain on the higher ridges throughout the warm summer months but move directly off the ridges with the first major snow fall. The downward movement from the summer

ranges to the winter ranges is direct, with minimal time spent on the transitional ranges. Usually, by late October or early November, all available forages on the higher ridges are made unavailable to the goats by heavy snow and thus, they are forced down onto their winter ranges until spring.

Typical winter ranges on the Pahsimeroi are extremely steep, rocky, and are southern exposed. Although often thought of in terms of escape habitat, the tendency to select extremely precipitous terrain, particularly in winter, is probably the evolutionary results of interspecific competition from the more mobile, aggressive mountain sheep, and not an avoidance of predators (Geist 1971). Throughout their evolutionary development, due to strong, interspecific pressure, mountain goats were forced into niches where winter habitat was physically and/or climatically too severe for other ungulates but still physicially situated to prevent the heavy accumulation of snow.

The selection of winter habitat was determined by the physical, snow shedding characteristics of an area and not the forage types present. Through the evolutionary development toward a specialized mountaineering species, which can function within the narrow physical parameters of their winter habitat, this species, consequently, has evolved to survive on a variety of forage types (Geist 1971). The snow shedding characteristic of mountain goat winter ranges on the Pahsimeroi are induced by isolation and gravity resulting in considerably lower snow accumulation on these steep southern exposures that are utilized by this mountain goat herd. The surrounding more shallow terrain is avoided by goats throughout the winter period.

In the winter period of 1969-1970, when this population was at its peak for the study period (166 animals), the herd was pushed down into 12 canyons along the Pahsimeroi and Salmon River drainages. These subpopulations, ranging from groups of 52 animals to lone billies, were restricted within these isolated canyons on critically small islands of snow free habitat for up to six months.

Under the traditional concepts of game management, if the habitat on the Pahsimeroi was controlling this goat population, as has been generally assumed for most other game populations, it would appear that food supplies on these small winter ranges, which were carrying this population half of the year, should be the ultimate determinant in the decline in goat numbers on the Pahsimeroi.

Through the examination of mountain goat feeding sites, Kuck (1971) demonstrated that browse provided the dominant class used by this goat herd throughout the winter period at 87 percent, followed by grasses and forbs at six and seven percent, respectively. Of all the forages utilized by mountain goats on the Pahsimeroi, curl-leaf mountain mahogany provided 75 percent of all the forages taken by goats throughout the winter period. Again, under the accepted criteria of ungulate management, the condition and trend of this mountain mahogany (key species) on the small, rocky cliffs (key area) and the ultimate balance between mountain goat population levels and the carrying capacity of these winter ranges should determine the trend in goat numbers.

After the Pahsimeroi goat herd declined from 217 goats to 95 animals in six years, the number of authorized permits was set at 20, with the stated purpose being to allow this population to recover. At the pre-study level of 20 permits, established in 1968, goat numbers appeared to increase to 166 goats on the Pahsimeroi. However, during the first three years of this study, when harvest levels remained essentially constant, the population started to decline after the documented peak of 166 goats during the 1969-1970 helicopter inventory (Fig. 2). Following the high of 166 animals in 1970, the population declined to 105 animals in 1971, and to 108 by 1972 despite a consrant and conservative harvest level. During this period, 13 goats were legally taken in 1969, prior to the population peak of 166 animals, followed by 14 goat kills in 1970, and an increase to 16 when the number of permits was increased to 25 for the 1971 goat season (Table 1).

Under these levels of exploitation, the utilization of the key browse plant, curl-leaf mountain mahogany, which was presumed to be carrying this population through the critical winter period, was constantly being severely utilized in excess of 60 percent. The percent of utilization on curl-leaf mountain mahogany for the first three years of the study was 70, 62, and 65 percent for the years 1970, 1971, and 1972, respectively, suggesting that this goat population was over utilizing its available winter forage and in danger of reducing the carrying capacity of its habitat.

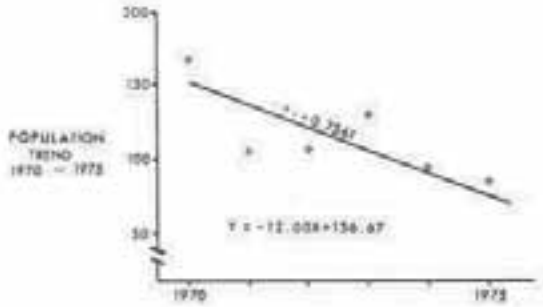

Figure 2. Population trend of the Pahsimeroi mountain goat herd from the winters of 1969-1970 through 1974-1975.

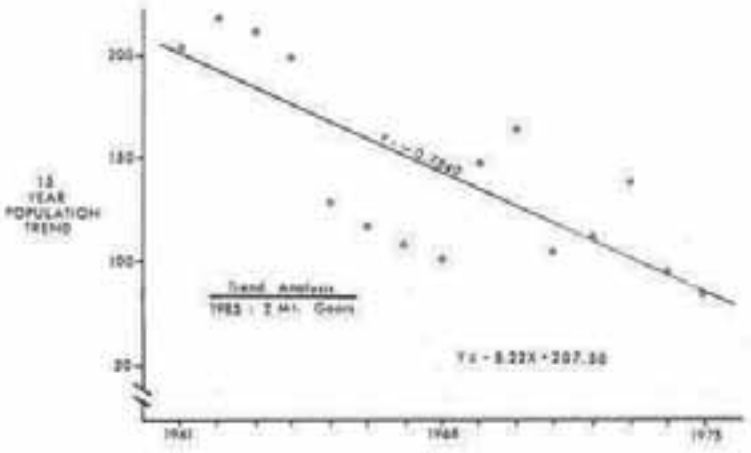

Figure 3. Fifteen year population trend, regression correlation, and trend analysis to 1985, for the Pahsimeroi mountain goat herd from 1961 through 1975.

Table 1. Authorised permits and harvest by year for the Pahsimeroi mountain goat herd during the course of this study.

Harvest Year	Authorized Permits	Documented Harvest
1969	20	13
1970	20	14
1971	25	16
1972	40	19
1973	36	17
1974	26	9

A reflection of the apparently low forage supplies on occupied winter ranges was the low production and survival of kids. Theoretically, under the law of compensation, this population should have responded with an increase in kid production in response to exploitation. However, the highest production of kids on the study area, 19 percent, corresponded with the peak population of 166 goats in 1970 (Fig. 3). This peak production year was followed by a reduction to 13 percent in 1971, and declined further in 1972 to only 11 percent kids in the total population.

After three years of presumably conservative harvests, during an era when the approach to game management was dominated by a philosophy being more advantageous to over harvest than under harvest, the Pahsimeroi mountain goat herd was still declining, forage utilization on occupied winter forages was severe, and kid survival was poor. Viewed from the traditional parameters of game management, the Pahsimeroi goats still appeared to be exceeding the carrying capacity of their habitat, and additional harvest was justified to prevent the continued destruction of their own habitat.

Manipulated Harvest

The broad application of contemporary game management principles to mountain goats assumes that, in the absence of significant natural predation, the artificial regulation of ungulate populations, through human exploitation, is justified to maintain these populations within the carrying capacity of their habitat to protect the range resource and to stimulate production of young through compensation (Cole 1971). The increase in authorized permits and corresponding harvest is presented in Table 1. These levels of harvest reduced this population from 131 animals in 1973 to 84 by 1975 (Fig. 2).

Under a sustained yield approach, this population declined over the five year study period by 82 animals. Through reducing the number of goats on the Pahsimeroi below winter range carrying capacity, our intention was to improve the production and condition of the winter range resource, thereby stimulating the production and survival of kids by providing abundant food supplies for remaining nannies. However, contrary to the law of compensation, kid production did not respond as expected; instead it dropped in proportion to the total number of goats. The production of kids declined significantly ($r=0.7649$) from the peak population of 166 goats with 19 percent kids, to a low of 7 percent kids in 1975. This corresponded with the low ebb in goats on the Pahsimeroi at 84 animals. The directly proportional decline in the ratio of adults to kids during this period was highly significant ($r=0.9834$).

Although the population was significantly reduced during the course of the study, the highly significant decline in kid production indicates that this goat population reacts contrary to traditional game management practices. After five years of manipulated harvest without an increase in kid production, the Pahsimeroi was closed to all forms of hunting following the 1974 season. In the absence of intercompensation to offset exploitation, a trend analysis of the 15 year history of the herd indicated that under past rates of exploitation, the Pahsimeroi goat herd would have been reduced to two animals by 1985 (Fig. 3).

This population apparently does not produce a surplus of harvestable goats as do deer and small game and, therefore, hunting mortality on the Pahsimeroi goat herd appears to be additive and not compensatory. Despite an apparent stable goat habitat on the Pahsimeroi, this population declined by 82 animals during the study. Most of these losses can be directly attributed to hunter mortality (Table 2). Seventy-five goats were taken legally during controlled hunts, 15 goats were taken by archery hunters during general archery seasons that overlapped a portion of

the study area, and 3 goats were killed due to other causes for a total exploitation of 93 goats. Considering the inherent inaccuracies of aerial surveys for estimating population size, as indicated by Caughley (1974), the evidence presented indicates that the goat decline on the Pahsimeroi can singularly be attributable to hunter mortality and the lack of compensation for this mortality.

Table 2. Documented exploitation by type from 1970 through 1975.

Exploitation Type	Documented Goat Kill
Gun Harvest	75
Archery Harvest	15
Other	3
Total	93

Caughley (1970) considers minor yearly population fluctuations of 5 to 10 percent to be normal for most ungulate populations. However, under contemporary principles, a continuing population decline in the excess of 50 percent over a five year period, such as found on the Pahsimeroi, would have to be induced by severe weather influences and/or an abrupt decline in available food supplies. Although winter conditions during this study were considered mild (Kuck unpubl.), major depletion or ecological alteratnion in available food supplies would normally be suspect for this population trend. However, the dominant winter food source for this population is curl-leaf mountain mahogany, a climax species, highly preferred by many ungulate species (Daley 1975). Yet, despite intense forage utilization, mountain mahogany and ungulates have evolved together, resulting in mountain mahogany being a browse resistant species, which invalidates the need to harvest goats to protect this particular forage resource.

Behavior

An analysis of the movement data for the 27 marked goats, 15 females and 12 males, displays a strong homing instinct in adult nannies but not in billies or young nannies (Kuck unpubl.). Characteristically all mature nannies returned each winter to the same winter range used the previous winter. Conversely, billies inconsistently selected different winter ranges from year to year. Differential mobility between sexes was minimal throughout the year except during the rut. Nanny movement during this period was directed toward traditional winter ranges, while billy movement highly intensified during the rut in search of receptive nannies. It was not uncommon for billies to shift from one canyon to another then back within a two or three day period. Individual winter range selection by billies appeared to be determined by its location at the cessation of the rut. In addition to location, a common difference in winter range selection between sexes was severity of terrain. Winter habitat utilized by marked nannies was consistently steeper having greater snow shedding characterisctics than habitat utilized by billies.

Behaviourally, a definite social order exists in mountain goats. This ranking has evolved through social aggressiveness which is based on dominance and submissiveness that is enhanced by the presence of horns on all adult mountain goats (Geist 1964, Chadwick 1973). Adult nannies, particularly those with kids at side, have obtained the dominant position within this social order. Through evolutionary necessity this dominant position has been obtained by nannies to protect their young defenseless kids from other socially aggressive goats. Also of equal evolutionary importance is the tendency by dominant nannies to consiatently select winter habitat with characteristically lower snow accumulation to reduce the energy expenditures in the obtainment of life sustaining nourishment for the nanny and her fetus. The aggressive intolerant nature displayed by dominant nannies permits the selection of the most favorable habitat (snow shedding terrain) within the typically harsh environment by the productive segment of a goal population to insure the continuation of the species. Food supplies are maintained in balance for the survival of dominant nannies on preferred winter cliffs by the dispersion of subdominant individuals, billies and young nannies, through aggressive behavioral mechanisms. Consequently, this aggressive behavior tends to disperse mountain goat populations in relation to both physical habitat and available food supplies. Therefore, mountain goat populations tend to self-regulate themselves without the need for artificial control by game management agencies. During periods of plentiful food supplies goat densities are high; however, when food supplies diminish through intraspecific competition, the rate of encounters between individuals increases. Therefore, faced with reduced food supplies, subordinate individuals are expelled from preferred cliffs through behavioral mechanisms to insure adequate food supplies for the survival of the productive segment of the population. Thus, mountain goats appear to disperse themselves in relation to both food and space, which prevents

the self-destruction of their habitat and eliminates production of surplus goats for harvest by sportsmen.

As a result of this aggressive behavior to disperse themselves in relation to food and space, goats on the Pahsimeroi at the peak population of 166 goats in the winter of 1970 occupied most of the suitable winter range within 12 different canyons (Fig. 4). However, following exploitation by 1975, this population had been reduced to 84 animals, and the proportion of habitat being used by these remaining goats was significantly smaller than in 1970 and was found in only 6 canyons compared to 12 canyons in 1970.

The primary determinant for the selection of these residual winter ranges following exploitations appeared to be physical snow shedding characteristics and not the available food supply. The steeper winter ranges tended to draw mountain goats following exploitation. The regression correlation between calculated steepness of slope and population change by canyon, display a direct significant correlation. During the five year period, the steeper the winter range, the less likely the goat population would decline ($r=0.7423$). Consequently the shallower unpreferred cliffs in terms of physical characteristic and not food supply, were more likely to be abandoned, over the five years of exploitation, while cliffs exceeding 40° or more suffered little or no population losses.

The validity of contemporary game management is based on the assumption that unharvested animals will redistribute themselves following exploitation in relation to available food supplies, in order to increase available foods for remaining individuals to stimulate the production of young. However, on the Pahsimeroi, when dominant animals were removed from preferred cliffs by hunters, these voids were refilled by subordinate animals from adjacent but shallower cliffs. This recessional behavior by the Pahsimeroi mountain goat herd therefore precludes the resting of available range resources and corresponding stimulation of young normally expected following exploitation.

The inherent tendency for mountain goats to select steep or snow shedding winter range in preference over food supplies, is analogous to yarding behavior documented in white-tailed deer (Severinghaus and Cheatum 1956). During the five years of the study, forage supplies on winter ranges still occupies in 1975 were as intensely utilized by goats in 1970 (84 percent) as in the spring of 1974 (88 percent) despite the heavy exploitation incurred by this population (Table 3). However, the intensity of utilization on abandoned winter ranges declined significantly but provided few benefits to remaining goats because of the recessional behavior toward steeper cliffs. Thus, remaining goats were continuously faced with depleted forage resources on preferred winter ranges, resulting in a direct proportional decline in the production of kids as this population regressed further each year following exploitation into steeper cliffs with constantly suppressed food supplies. Although the selection of steep cliffs precludes the production of young, when food supplies are low, this behavior does insure the survival of the individual.

Table 3. Changes in forage utilization on curl-leaf mountain mahogany from 1970 to 1974, for winter ranges abandoned by 1975 and still occupied in 1975.

Year	Winter Ranges Abandoned by 1975	Winter Ranges Occupied in 1975
1970	62.2 %	84.1 %
1974	45.2 %	87.7 %

As a result of these depressed food supplies on preferred cliffs, kid production was not stimulated, consequently, hunter mortality was additive and not compensatory. Thus, in 1970, winter ranges that were later abandoned, produced 22 kids or 69 percent of the goats produced that year, with the remaining 10 kids (34 percent) being produced on the steeper cliffs that were still occupied in 1975 (Table 4). However, following exploitation and the abandonment of the shallower cliffs which were producing most of the kids in 1970, only three kids were produced in the occupied steeper cliffs in 1975. In response to exploitation, kid production had declined from 19 percent in 1970 to 7 percent in 1975.

Relative population density and distribution for the Pahsimeroi mountain goat herd for 1970 and 1975.

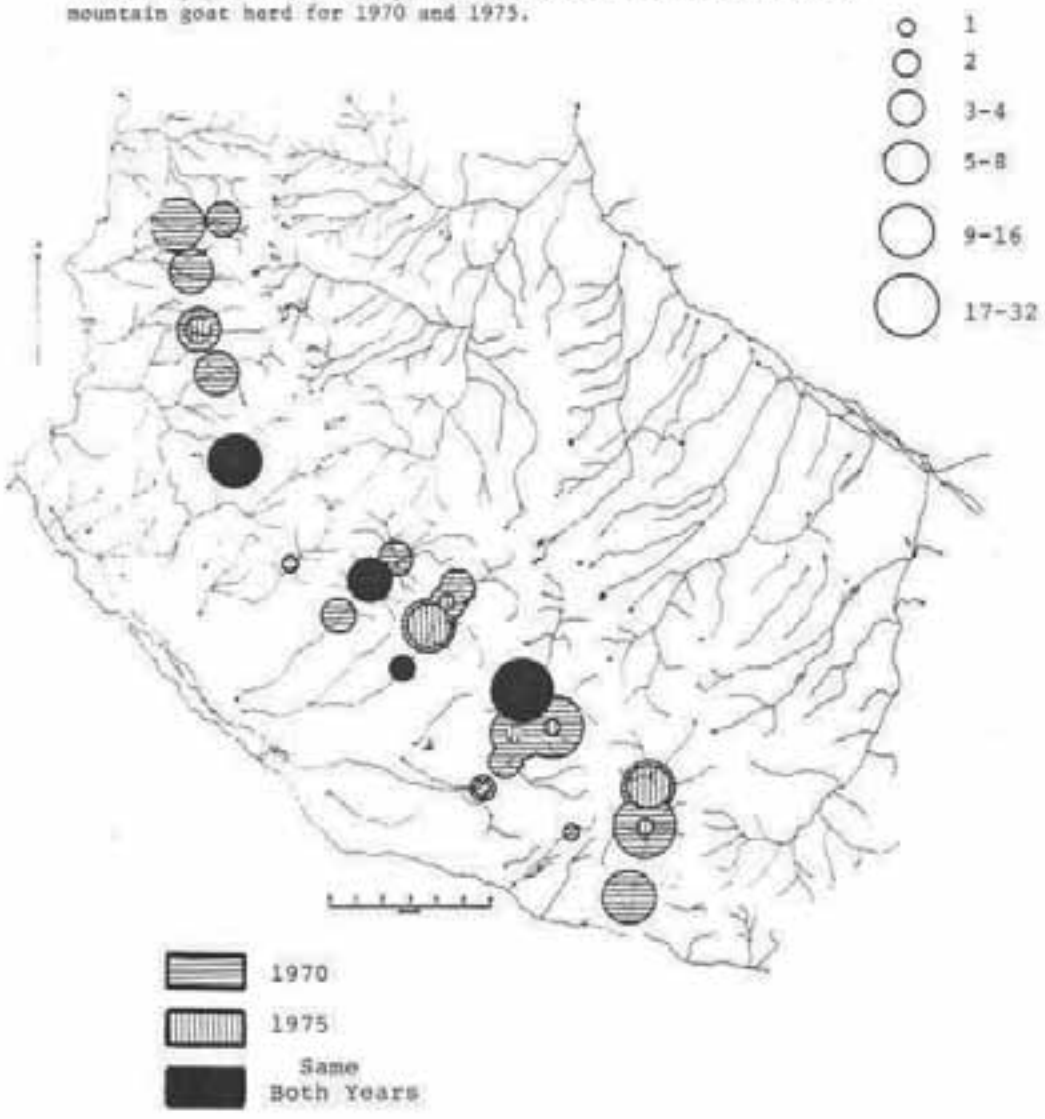

Figure 4. Circle size indicates relative size of mountain goat subpopulation by canyon. Horizontal distribution in 1970; vertical 1975. Black indicates populations remained constant both years.

Table 4. Changes in kid production from 1970 to 1975, on winter ranges abandoned by 1975 and still occupied in 1975.

Year	Winter Ranges Abandoned by 1975	Winter Ranges Occupied in 1975
1970	22 (69%)*	10 (31%)
1975	0	3 (100%)

* No. kids (% of total goats)

The creation of mountain goat habitat is a function of glaciation, therefore, during periglacial periods, goat habitat is relatively stable. Consequently, in the absence of dynamic expansion of goat habitat, there is little need for the production of surplus young. Without a natural mechanism to suppress the production of young, the limited goat habitat would rapidly be over-saturated leading to the self-destruction of their own habitat and potential extinction of the species. It appears, as goat populations reach the saturation point of their habitat or are exploited as on the Pahsimeroi, the over-imbalance between the popualtion levels and forage supplies proves inadequate for the production of viable kids as in white-tailed deer (Verme 1962).

Conclusions

Mountain goats in Idaho have traditionally been hunted conservatively under a controlled permit system. The intensive manipulated harvest system tested and evaluated in the present paper exposed less than two percent of Idaho's mountain goats to this excessive harvest rate. However, the response of the Pahsimeroi goat herd to the intentional increase in harvest demonstrated that many of the assumptions previously used to justify the harvest of mountain goats are not valid, at least on the Pahsimeroi. Because when exploited, this herd progressively selected steeper winter ranges, consequently, the traditional concepts of stimulating the production of young, the increased forage supplies were not realized. Consequently, hunter mortality proved to be additive and not compensatory as expected. As a result of this study, Idaho's future approach to mountain goat management will be considerably more conservative.

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