UTAH MOUNTAIN GOAT
STATEWIDE MANAGEMENT PLAN

UTAH DIVISION OF WILDLIFE RESOURCES
DEPARTMENT OF NATURAL RESOURCES

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STATEWIDE MANAGEMENT PLAN FOR MOUNTAIN GOAT

I. PURPOSE OF THE PLAN

A. General

This document is the statewide management plan for mountain goats in Utah. The plan will provide overall guidance and direction to Utah's mountain goat management program. The plan assesses current information on mountain goats, identifies issues and concerns relating to mountain goat management in Utah, and establishes goals and objectives for future mountain goat management programs. Strategies are also outlined to achieve the goals and objectives. This plan will be used to help determine priorities for mountain goat management and provide the overall direction for management plans. Unit management plans will be presented to the Utah Wildlife Board when one of the following criteria are met: 1) a new mountain goat unit is being proposed, 2) the current unit requires a significant boundary change, 3) a change to the unit population objective is being proposed, or 4) the unit has not yet had a management plan approved by the Utah Wildlife Board. All other changes to unit management plans will be approved by the Division Director.

B. Dates Covered

The statewide mountain goat plan was approved by the Utah Wildlife Board on November 29, 2018 and will be subject to review within 10 years.

II. SPECIES ASSESSMENT

A. Natural History

Mountain goats (*Oreamnos amreicanus*) are not true goats as the name suggests, but share the family Bovidae with true goats (*Capra* spp.), gazelles (*Gazella* spp.) and cattle (*Bos* spp.). They are in the subfamily Caprinae along with 32 other species including sheep (*Ovis* spp.) and muskoxen (*Ovibos* spp.). Mountain goats are the only living species in the genus *Oreamnos*.

Mountain goat males, females, and young are known as billies, nannies, and kids, respectively. Kids are born after a gestation period of approximately 190 days most often as singles, but twins are not uncommon. Kids are normally born in mid-May to early-June. Compared to similarly sized ungulates, mountain goats have a surprisingly late age of first reproduction. In established populations, females often do not give birth until 4 or 5 years old (Festa-Bianchet et al. 1994). In newly translocated populations, females can reproduce as early as 2 or 3 years old (Bailey 1991, Festa-Bianchet and Côté 2008).

Like many ungulates, mountain goats put on weight and fat reserves during the spring and summer months for use during winter. For this reason, weights vary greatly depending on when they are measured. In late summer, a typical mature male will weigh about 175-225 pounds. Females are smaller and typically average between 125 and 150 pounds. Both males and

females continue to gain body mass until about 6 years old when they are considered fully-grown. The maximum life span of mountain goats is typically around 15 years old for males and 18–20 years old for females (Festa-Bianchet and Côté 2008).

Both male and female mountain goats have horns. For both sexes, horn growth begins at birth and the vast majority of horn growth occurs during the first 3 years of life. Horn growth for mature adult goats (4+) is minimal. There is little sexual dimorphisms exhibited in mountain goats. Horn length of males and females is similar, but male horns tend to be 10-20% thicker at the base than females (Festa-Bianchet and Côté 2008).

The mating period for mountain goats peaks in mid-November and individual females come into estrus for about 2 days. During this time, males seek out females in estrus and defend them from other males. Unlike most ungulates where males fight by clashing or locking horns or antlers, mountain goats have an antiparallel fighting style. During these interactions, males circle each other with each goats head aligned with the others rump. Outside the mating season, males and females generally remain segregated.

B. Management

1. UDWR Regulatory Authority

The Utah Division of Wildlife Resources (UDWR) presently operates under authority granted by the Utah Legislature in Title 23 of the Utah Code. The UDWR was created and established as the wildlife authority for the state under Section 23-14-1 of the Code. This Code also vests UDWR with its functions, powers, duties, rights, and responsibilities. UDWR's duties are to protect, propagate, manage, conserve, and distribute protected wildlife throughout the state.

The UDWR is charged to manage the state's wildlife resources and to assure the future of protected wildlife for its intrinsic, scientific, educational, and recreational values. Protected wildlife species are defined in code by the Utah Legislature. Mountain goats have been listed as a protected species in Utah since 1919.

2. Population Status

Mountain goats currently inhabit several mountain ranges in Utah including numerous peaks along the Wasatch Front, Uinta Mountains, Tushar Mountains, and La Sal Mountains (Figure 1). All current populations are the result of introductions; the first of which occurred in 1967 when 6 mountain goats (2 billies, 4 nannies) were released in the Lone Peak area (Table 1). Within Utah, 30 separate transplant events have occurred and 276 mountain goats have been released. Initial transplants used mountain goats from Olympic National Park in Washington as the source herd. After those transplanted herds became established, they became source herds for future transplants. The Tushar Mountains population has been the most common Utah source herd because of its rapidly growing population and relative ease of accessibility. The number of mountain goats in Utah had generally increased from 1967 to 2011 reaching nearly 2,100 animals; since that time, the estimated number of mountain goats in Utah has decreased and stabilized at approximately 1,900 animals (Figure 2).

3. Past and Current Management

In Utah, mountain goat populations are surveyed via helicopter every 2-3 years (Table 2). During these flights, biologists survey all potential mountain goat habitat in August or September and classify all observed animals as adults, or kids. Previous studies have shown that sightability is usually around 80-85% for mountain goats (Rice et al. 2009). In addition to the helicopter surveys, most biologists conduct ground-based or fixed-wing classification counts on units during years when they are not surveyed with a helicopter. This provides biologists with data on annual production and greatly improves our population models for those units.

Mountain goats are managed as an once-in-a-lifetime species in Utah. The first mountain goat hunt in Utah was held on Lone Peak in 1981 where 1 permit was issued. Since 1981 the greatest number of permit issued in a given year was 175 in 2012 (Table 3). From 1981 to 2017, a total of 1,851 permits have been issued resulting in the harvest of 1,759 mountain goats (1,158 billies and 601 nannies). Success rates for mountain goats in Utah are high and average 95%. On the Beaver and Ogden units, where additional measures are needed to control goat populations, UDWR has issued nanny-only permits in addition to any-goat permits. On units where population control is not needed, any goat permits have been issued to harvest any adult goat. Historically, 66% of mountain goat hunters with any-goat permits have harvested billies. The average age of mountain goats harvested in Utah was 4.4 years old in 2017 (Table 4). Demand for permits is extremely high making these permits difficult to draw (Table 5). In 2017, a total of 12,657 hunters applied for the 104 public draw permits available resulting in drawing odds of 1 in 121.

C. Habitat

Mountain goats are obligate occupants of subalpine and alpine environments in Utah. Elevations of up to 13,000 feet are frequented in summer, and winter habitat may be high as 12,000 feet on windblown ridges of some units. Mountain goats prefer steep and rugged areas where these sure-footed animals can escape predators; typically selecting for escape terrain with an intermediate slope typically between 20 and 50 degrees (Gross et al. 2002). Mountain goats in Utah are often found above tree-line as well as in forested subalpine zones where they utilize a variety of grasses, forbs, shrubs, and lichens. Exposed, precipitous cliffs are an essential component of mountain goat habitat. Suitable sites encompass most aspects of mountain goat habitat needs including escape terrain, feeding sites, and birthing and nursery areas.

Food habits of goats are extremely variable among different geographic populations. In general, summer diets are typically dominated by succulent grasses and forbs. Winter diets may include a much higher browse or shrub component, and may even include Ponderosa pine, lodgepole pine, or alpine fir as well as the mosses and lichens that can be found on these trees. Other components of goat habitat that may be locally important include mineral licks and dusting areas used to alleviate heat or ectoparasite load.

III. ISSUES AND CONCERNS

A. Native Status

A number of records exist that document the historical presence of mountain goats in Utah prior to reintroduction efforts that began in 1967. An analysis of available information is included as an appendix to this document (Appendix A). However, there are not as many documented records as with some other wildlife native to Utah, which has led to some controversy about their native status. Regardless of the controversy, they are certainly native to the Northern Rocky Mountains and neighboring states to Utah. UDWR's position is that mountain goat habitat exists in Utah and that mountain goats are a valuable part of our wildlife resource diversity and are a legitimate part of our modern Utah faunal landscape. As with any other ungulate species in our now pervasively human-altered ecosystem, they require pro-active management.

B. Habitat Impacts

Mountain goat utilization of the available forage should be closely monitored. UDWR is committed to working closely with land management agencies to monitor habitat conditions in mountain goat habitat. Although goat densities in Utah are typically low, local areas may exhibit heavy use if animals congregate in specific areas. If mountain goat use is demonstrated to be excessive, UDWR will work cooperatively with the U.S. Forest Service (USFS) and Bureau of Land Management (BLM) to manage goat populations to acceptable numbers. As part of this plan, target population sizes for individual goat herd units will be reviewed for existing management units or developed for new units. Where habitat monitoring data exists, those data will be used to help determine the target population size.

In addition to their direct utilization of forage, mountain goats will also disturb soil to bed and dust bathe. In unregulated populations of mountain goats, this disturbance has caused concern. In regulated populations and at the densities observed in Utah, this disturbance is considered normal behavior of goats and other ungulates. Comparable disturbance is observed at elk wallows and on bighorn sheep lambing and wintering cliffs, even at low population densities. UDWR has observed habitat recovery in these disturbed sites, including at alpine elevations in Utah when the disturbance is caused by mountain goats.

C. Disease

Little information is available relative to disease in mountain goats (Côté and Festa-Bianchet 2003). However, there are some documented occurrences of disease that may be of concern for mountain goats in Utah including contagious ecthyma, Johne's disease, and respiratory pneumonia. Contagious ecthyma is a highly contagious parapox virus that causes blister-like sores to form on the face and muzzle of infected animals. The virus can lay dormant in soil for long periods and enters the host through skin abrasions. Lesions can be extremely painful causing an animal to not feed, leading to emaciation and ultimately death. It is believed that mountain goats may suffer severely from this disease with documented outbreaks resulting in deafness, blindness, and ultimately death (Samuel et al. 1975). Lesions typically last about 2-4

weeks after which an animal may recover. This disease has been observed in domestic sheep flocks for over 200 years (Lance et al. 1981).

Between 1972 -1978, the Colorado Division of Wildlife collected several bighorn sheep and a sympatric mountain goat carcass with lesions consistent with infection from the bacteria *Mycobacterium avium*, commonly referred to as Johne's disease or paratuberculosis (Williams et al. 1979). Mountain goats are believed to be highly susceptible to the disease, leading to severe gastrointestinal distress, emaciation, dry or rough hair coat, and death (Williams et al. 1983). The disease primarily affects lambs and transmission of the disease may occur *in utero* or in the first few months of life through ingestion of contaminated food, water, dust, or feces (Kimberling 1988). This disease is most commonly associated with cattle; however adult sheep, goats, and llamas can be carriers (Garde et al. 2005).

Respiratory pneumonia associated with *pasteurella* spp. and *mannheimia* spp. of bacterium have been reported sporadically in mountain goats, but large scale die-offs have rarely been documented (Garde et al 2005). Several strains of the bacteria are carried as common commensals in the upper respiratory tract. Transmission of these bacteria can occur through direct contact or aerosolization (Garde et al. 2005). In 2010, the Nevada Department of Wildlife documented a pneumonia related die-off in mountain goats and sympatric bighorn sheep in the Ruby Mountains (Peregrine Wolff, personal communication Nevada Department of Wildlife). Disease transmission between mountain goats and bighorn sheep is not well understood and UDWR will continue to investigate the important relationship between these two species. Other concerns include myopathy that may result from selenium deficiency (Côté and Festa-Bianchet 2003) and possibly some parasites such as lungworm.

D. Predation

Predation does not seem to be a limiting factor to mountain goat population growth in Utah. This is likely due to the absence of many mountain goat predators from Utah. Festa-Bianchet and Côté (2008) found that grizzly bears (*Ursus arctos*), wolves (*Canis lupus*) and cougars (*Puma concolor*) were the most effective predators of mountain goat in British Columbia. Cougars are potential predators of mountain goats in Utah, but are more likely to target easier prey such as mule deer, elk, and bighorn sheep. If predation is shown to be an issue on a particular unit, UDWR can increase predator hunting in specific areas or establish a predator management plan for that unit.

E. Wilderness and Park Management

Many wilderness areas in Utah currently have populations of mountain goats. These areas include the High Uintas, Lone Peak, Mt. Olympus, Twin Peaks, and Mt. Timpanogos. In order to properly manage mountain goat populations in these areas, it is critical that biologists have all possible management tools available to them if needed. These include but are not limited to the use of aircraft for surveys, transplants (captures and releases), hunting, and research projects. Any future wilderness designations or park expansions should also allow for these activities. UDWR must continue to work cooperatively with the USFS and BLM on wilderness-related issues to ensure the proper management of mountain goats in these areas. Certain activities

proposed in wilderness areas may necessitate coordination with appropriate land management agencies.

F. Competition with Bighorn Sheep

Mountain goats and Rocky Mountain bighorn sheep typically occur in broadly similar habitats, at similar elevations, and consume many of the same forages. Thus, the potential exists for competition between these two species, particularly when seasonal habitat overlap occurs (Hobbs et al. 1990, Laundre 1994, Gross 2001). However, even where both are present, resource partitioning appears to minimize conflicts (Laundre 1994). Specifically, there is enough disparity in site selection, seasonal use, and forage preference such that range overlap does not result in as much direct competition as expected when each species' habitat requirements are considered separately.

In Utah, sympatric bighorn sheep and goat populations are found only in the eastern Uinta Mountains and to a lesser extent along the Wasatch Front. In these areas, the abundance of alpine habitat combined with the low densities of mountain goats and bighorn sheep, greatly minimizes any interspecies competition. Range overlap of mountain goats and bighorn sheep does not currently occur in other areas of Utah, largely due to domestic and wild sheep disease issues that prohibit wild sheep. In some areas, there is also a general lack of suitable bighorn sheep wintering areas.

G. Poaching

Poaching of mountain goats is less common than other ungulate species due to the remote nature of their habitat. There are some documented cases of mountain goat poaching in Utah, but they are rare. Poaching likely has no population level effect, but does reduce hunting opportunity for law-abiding hunters. Mountain goat populations are small and due to their low reproductive rate, only a small proportion of the population can be harvested. With less than 200 permits currently issued, one poached animal is proportionately a large loss in opportunity.

Most poaching cases of mountain goats occur when a hunter with a female-only permit mistakenly identifies an animal and accidentally harvest a male. Typically, the hunters report their mistake, but this situation can lead to overharvesting males if this becomes too prevalent. Other poaching incidents usually occur when a hunter cannot access the goat he shot due to the rugged terrain or the animal was damaged from falling after it was shot. UDWR investigates all reported poaching cases. The high profile nature of mountain goats and their limited distribution adds concern to these investigations.

H. Transplants

All of the mountain goat populations that currently exist in Utah are a result of transplants or dispersal from transplants. Although mountain goats can pioneer to new areas when densities are sufficiently high, transplants continue to be the preferred method used to establish new mountain goat populations and supplement existing ones. Mountain goat transplants in Utah have typically been successful provided the habitat on the site is suitable and a sufficient number

of goats have been released. Transplant sites are carefully selected using habitat models, vegetation surveys, and meetings with interested stakeholders.

Although most suitable mountain goat habitat in Utah is already occupied, several potential sites for new transplants still exist (Appendix B). Additionally, some existing units may need to be augmented to bolster population growth. It is critical that UDWR work closely with the USFS and BLM to ensure the success of any future relocation efforts. Careful monitoring of vegetation will be needed to alleviate concerns for alpine vegetation.

There are a number of mountain goat populations in Utah that could serve as source herds for augmentation or to start new populations within Utah or in other states. For many of these populations, wilderness designated lands are one of the largest barriers to catching animals. UDWR, USFS, and BLM will need to work cooperatively to determine the suitability of helicopter access for possible transplant and GPS collaring projects.

IV. USE AND DEMAND

In Utah, mountain goats are one of the easier to draw permits for an once-in-a-lifetime species, likely due to the extremely rugged terrain they inhabit. Even so, the demand for these permits is still high and far exceeds permit supply. In Utah for 2012, applications exceeded available permits by 68:1 for residents and 621:1 for nonresidents. Applications for both resident and nonresidents have increased every year since the initiation of Utah's draw system (Table 5).

In addition to hunting, viewing mountain goats is one of the most exhilarating and memorable experiences available to users of high alpine areas in Utah. The closeness of some of Utah's mountain goat populations to the Wasatch front helps contribute to the interest of wildlife viewers in watching mountain goats. Public perception of goat viewing opportunities is overwhelmingly positive, and the Watchable Wildlife events for mountain goats are some of the most popular events hosted by the UDWR. UDWR's goal is to foster and promote these opportunities wherever possible and enable people to see this unique species.

V. CONCLUSION

Mountain goats personify the high lonesome reaches of western North America. Goats are adapted to live in the highest, coldest, snowiest and most precipitous reaches of our classic western mountain ranges. The image of a solitary goat on a ridiculously narrow rock ledge on a seemingly inaccessible cliff is one that once seen is never forgotten. For over 50 years, UDWR has carefully managed Utah's mountain goat populations so herds are productive and balanced with available habitat. UDWR plans to continue this management approach, while also establishing new mountain goat populations where possible. This will allow UDWR to expand both hunting and viewing opportunities for mountain goats while ensuring their long-term viability in Utah.

VI. STATEWIDE MANAGEMENT GOALS AND OBJECTIVES

A. Population Management Goal: Establish sustainable populations of mountain goats by utilizing suitable habitat within the state to create and foster individual populations.

Objective 1: Increase mountain goat populations within the state as conditions allow.

Strategies:

a. Develop or revise all management plans for individual units making sure to include population goals and objectives.
b. Survey all herd units by helicopter every 1–3 years to monitor population size and composition.
c. Use population or sightability models to determine the relationship between population surveys and population size.
d. Utilize GPS collars to better understand movements and aid in estimating abundance of mountain goats.
e. Translocate and/or harvest animals from populations where habitat concerns exist due to high goat densities or where populations are above objective.
f. Augment existing populations where needed to improve herd distribution, link small populations, and improve genetic diversity (Appendix B). Depending on location, augmentation activities may need to be coordinated with the appropriate federal land management agency.
g. Transplant mountain goats to establish new populations in accordance with Utah Code 23-14-21 (Appendix B). Depending on location, augmentation activities may need to be coordinated with the appropriate federal land management agency.
h. Participate in research efforts to monitor adult and kid survival and determine reasons for poor kid recruitment and population declines in units where needed.
i. Support law enforcement efforts to reduce illegal taking of mountain goats.

B. Habitat Management Goal: Provide good quality habitat for healthy populations of mountain goats.

Objective: Maintain or improve mountain goat habitat to enhance individual population success and promote the overall sustainability of mountain goats statewide.

Strategies:

a. Identify mountain goat habitats and work with land managers to protect and enhance these areas.
b. Assist land management agencies in monitoring mountain goat habitat. Habitat monitoring by the land management agencies will be contingent on available funding and personnel.
c. Work with land managers to minimize and mitigate loss of mountain goat habitat.
d. Inform and educate the public concerning the needs of mountain goats.

C. Recreation Goal: Provide quality opportunities for hunting and viewing mountain goats.

Objective 1: Increase hunting opportunities as populations allow while maintaining high quality hunting experiences.

Strategies:

a. Recommend mountain goat permits (including female only permits) to make progress towards population objectives contained in unit management plans.
b. Recommend mountain goat permits to harvest 5%-25% of the counted adult population.
c. Use subunits to maximize hunting opportunities and improve hunter distribution.
d. When feasible, use multiple seasons to maximize hunting opportunities and minimize hunter conflicts.
e. Require mountain goat orientation course for all hunting permit holders. Encourage hunters to avoid harvesting nannies with hunter's choice permits.
f. Explore providing a greater variety of hunting opportunities by utilizing more primitive weapons, variation in season length, and more variable season dates.

Objective 2: Increase public awareness and expand opportunities to view mountain goats.

Strategies:

a. Look for ways to expand mountain goat viewing opportunities for the public.
b. Ensure that information about mountain goats published on the Division's website, social media channels, and print products is current and accurate.
c. Work with partner entities (state and federal agencies, conservation groups, agricultural stakeholders, etc.) to help educate the public about the value of mountain goats on the landscape, as well as the threats the species faces.

Figure 1. Mountain goat distribution, Utah 2017.

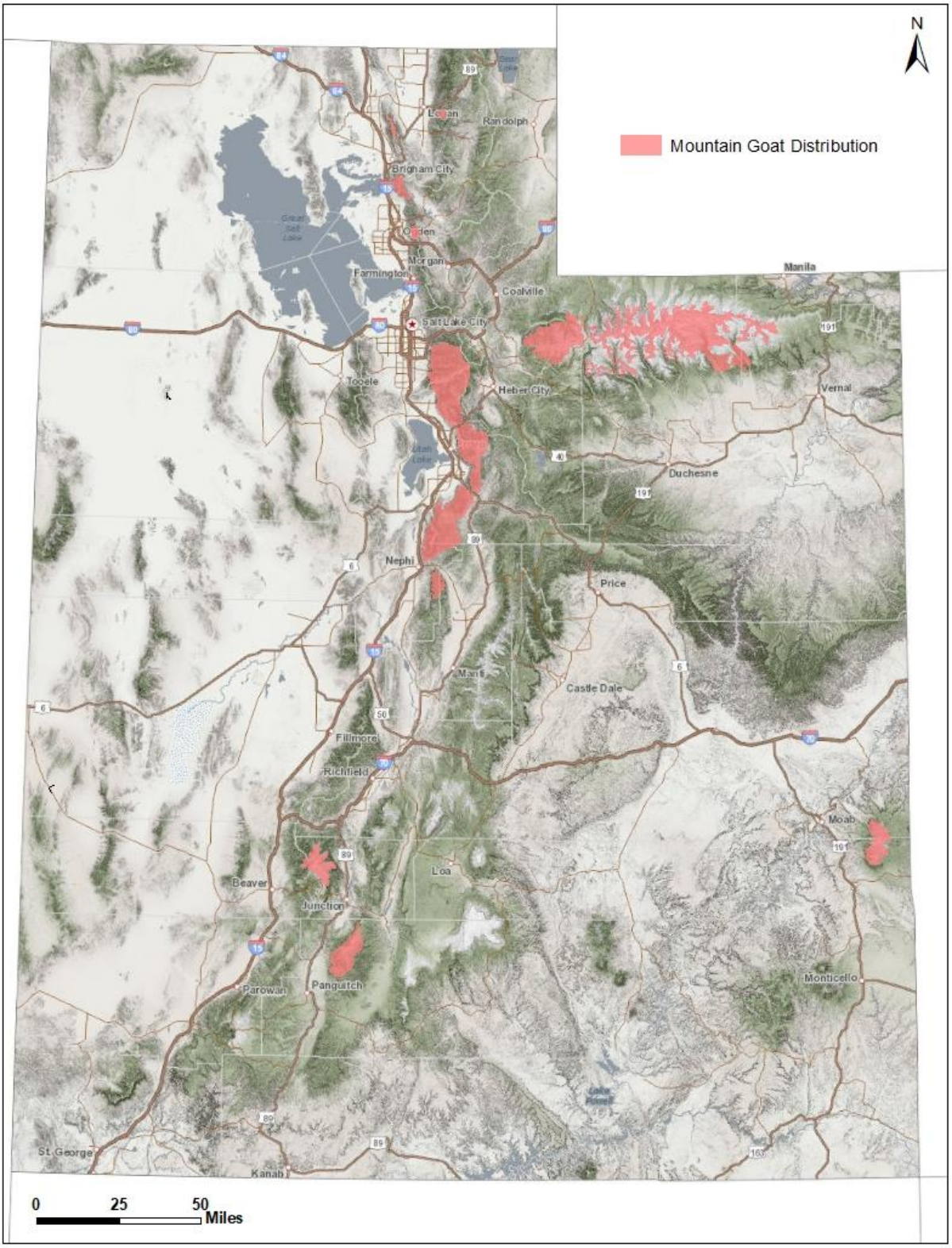

Figure 2. Mountain goat population trends, Utah 1975–2017.

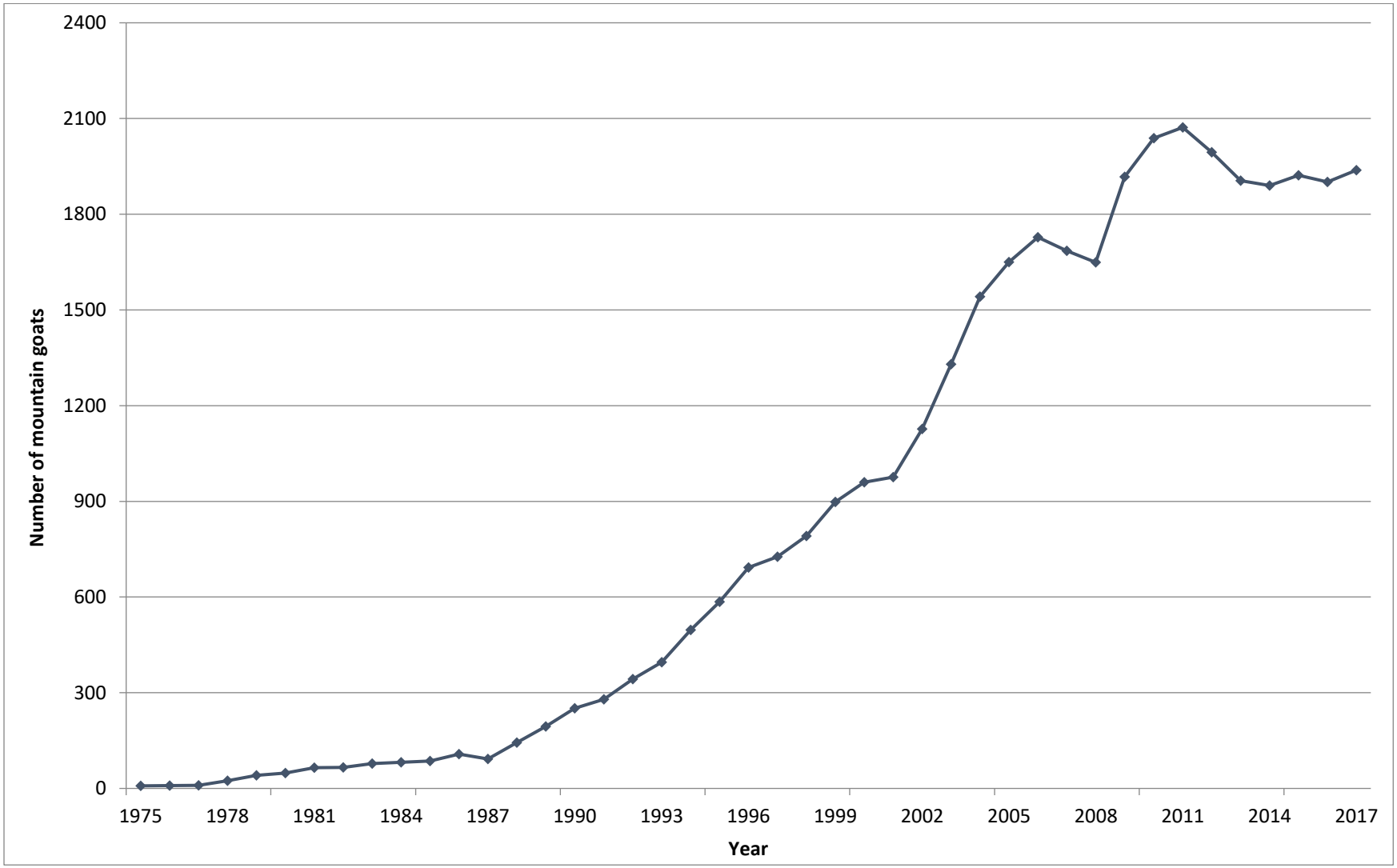

Table 1. History of mountain goat transplants, Utah 1967–2017.

Unit #	Unit	Area Released	Year	# Released	Source
3	Ogden	Willard Peak	1994	5	Lone Peak, UT
3	Ogden	Willard Peak	2000	4	Provo Peak, UT
7	Kamas	Bald Mountain, Uintas	1987	7	Lone Peak, UT
7	Kamas	Bald Mountain, Uintas	1988	16	Olympic NP, WA
8 / 9	North Slope/South Slope	Whiterocks Canyon, Uintas	1989	9	Olympic NP, WA
8 / 9	North Slope/South Slope	Whiterocks Canyon, Uintas	1989	1	Kamas, UT
8 / 9	North Slope/South Slope	Whiterocks Canyon, Uintas	1992	13	Lone Peak, UT
8 / 9	North Slope/South Slope	Chepeta Lake, Uintas	1996	7	Tushar Mountains, UT
8 / 9	North Slope/South Slope	Liedy Peak, Uintas	1996	3	Tushar Mountains, UT
8 / 9	North Slope/South Slope	Marsh Peak, Uintas	1996	5	Tushar Mountains, UT
8 / 9	North Slope/South Slope	Brown Duck Peak, Uintas	1997	7	Tushar Mountains, UT
8 / 9	North Slope/South Slope	South Fork of Rock Creek, Uintas	1997	5	Tushar Mountains, UT
8 / 9	North Slope/South Slope	Center Park, Uintas	2000	8	Tushar Mountains, UT
8 / 9	North Slope/South Slope	Jefferson Park, Uintas	2000	9	Tushar Mountains, UT
13	La Sal Mountains	Beaver Basin	2013	20	Tushar Mountains, UT
13	La Sal Mountains	Beaver Basin	2014	15	Tushar Mountains, UT
16	Central Mountains	Loafer Mountain	2007	20	Tushar Mountains, UT
16	Central Mountains	Nebo	2013	10	Tushar Mountains, UT
16	Central Mountains	Nebo	2013	11	Willard Peak, UT
17	Wasatch Mountains	Lone Peak	1967	6	Wantachee, WA
17	Wasatch Mountains	Mount Olympus	1981	10	Olympic NP, WA
17	Wasatch Mountains	Mount Olympus	1981	4	Unknown
17	Wasatch Mountains	Mount Timpanogos	1981	10	Olympic NP, WA
17	Wasatch Mountains	Provo Peak	1989	7	Olympic NP, WA
17	Wasatch Mountains	Provo Peak	1990	5	Mount Timpanogos, UT
22	Beaver	Tushar Mountains	1986	6	Lone Peak, UT
22	Beaver	Tushar Mountains	1986	1	Mount Timpanogos, UT
22	Beaver	Tushar Mountains	1988	17	Olympic NP, WA
24	Mt Dutton	Cottonwood Peak & Mt Dutton Peak	2013	25	Willard Peak, UT
24	Mt Dutton	Cottonwood Peak & Mt Dutton Peak	2015	21	Willard Peak, UT
—	Idaho	Lemhi Mountains	2007	24	Tushar Mountains, UT
—	South Dakota	Black Hills	2013	22	Tushar Mountains, UT

Table 2. Mountain goat trend counts by unit, Utah 2008–2017.

Unit	Year established	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Beaver	1986	133	206	—	240	—	222	—	215	—	—
Mt Dutton	2013	—	—	—	—	—	25*	—	—	47	—
Central Mountains, Loafer Mountain	2007	—	—	—	—	26	—	19	37	—	20
Central Mountains, Nebo	2007	—	—	—	—	22	—	20	29	—	91
Kamas / Chalk Creek	1987	37	108	—	91	—	—	129	—	—	103
North / South Slope, High Uintas Central	1989	153	210	—	197	—	—	206	—	—	220
North / South Slope, High Uintas East	1996	95	81	—	89	—	—	64	—	—	55
North / South Slope, High Uintas Liedy Peak	1996	58	77	—	41	—	—	44	—	—	52
North / South Slope, High Uintas West	1987	236	294	—	440	—	—	392	—	—	303
Ogden, Willard Peak	1994	115	193	218	252	—	205	197	188	148	—
Wasatch Mountains, Box Elder Peak	1967	—	—	54	—	30	—	34	31	—	36
Wasatch Mountains, Lone Peak	1967	—	—	67	—	13	5	27	41	—	44
Wasatch Mountains, Provo Peak	1989	—	—	104	—	79	—	75	76	—	53
Wasatch Mountains, Timpanogos	1981	—	—	118	—	64	—	76	92	—	81
La Sal, La Sal Mountains	2013	—	—	—	—	—	20*	—	—	43	56

*Initial transplant

Table 3. Mountain goat harvest statistics, Utah 1981–2017.

Year	Permits issued	Billy harvest	Nanny harvest	Total harvest	Hunters afield	Success rate (%)	Mean days hunted
1981	1	1	0	1	1	100	2
1982	1	0	1	1	1	100	2
1983	3	3	0	3	3	100	4.3
1984	4	2	1	3	4	75	4
1985	3	3	0	3	3	100	5.3
1986	4	2	2	4	4	100	6.5
1987	4	3	1	4	4	100	3.8
1988	4	3	1	4	4	100	3.5
1989	5	4	1	5	5	100	3.6
1990	6	4	0	4	6	67	4.8
1991	6	3	3	6	6	100	7
1992	8	8	0	8	8	100	5.8
1993	7	6	1	7	7	100	4.3
1994	10	10	0	10	10	100	—
1995	12	10	2	12	12	100	—
1996	19	16	2	18	19	95	4.2
1997	19	17	2	19	19	100	—
1998	19	18	0	18	19	95	3.5
1999	20	18	2	20	20	100	—
2000	29	19	9	28	29	97	3.2
2001	30	21	9	30	30	100	—
2002	36	25	10	35	36	97	—
2003	41	32	9	41	41	100	2.3
2004	46	31	15	46	46	100	2.6
2005	68	42	21	63	65	97	3.5
2006	94	48	38	86	93	92	3.3
2007	96	55	36	91	96	95	3.3
2008	95	58	30	88	93	95	2.9
2009	108	77	30	107	107	100	2.8
2010	115	70	41	111	114	97	3.0
2011	143	91	42	133	142	94	3.4
2012	175	94	73	167	174	96	2.6
2013	170	87	70	157	166	95	2.7
2014	115	74	36	110	115	96	3.1
2015	118	77	35	112	117	96	3.2
2016	106	63	40	103	104	99	3.8
2017	111	63	38	101	107	94	3.5

Table 4. Mountain goat average age of harvest, Utah 2010–2017.

Management unit	Average age								3-year average
	2010	2011	2012	2013	2014	2015	2016	2017	
Beaver	4.9	4.9	5.0	3.5	5.1	4.7	4.6	3.9	4.4
Kamas/Chalk Creek	4.6	6.5	3.3	6.3	5.0	5.3	6.7	2.0	4.7
North / South Slope, High Uintas Central	5.8	4.0	3.6	4.8	3.5	4.8	5.4	3.2	4.5
North / South Slope, High Uintas East	5.0	11.0	7.0	4.7	6.5	7.8	3.5	6.3	5.9
North / South Slope, High Uintas Liedy Peak	3.5	3.8	7.5	10.0	6.0	3.0	7.0	4.0	4.7
North / South Slope, High Uintas West	3.0	4.8	4.8	4.5	5.8	4.8	5.8	5.7	5.4
Ogden, Willard Peak	3.7	4.1	3.9	3.6	2.8	3.6	3.7	2.9	3.4
Wasatch Mountains, Box Elder Peak	9.0	—	6.0	7.7	5.0*	6.0*	2.0*	3.5*	3.8
Wasatch Mountains, Lone Peak	10.0	3.0	3.5	9.0	—	—	—	—	—
Wasatch Mountains, Provo Peak	5.8	4.0	4.0	5.3	5.5	10.0	3.0	6.7	6.6
Wasatch Mountains, Timpanogos	6.4	4.5	3.0	6.3	—	—	—	—	—
Central Mountains, Nebo	—	—	—	3.0	2.0	3.0	—	3.5	3.3
Mt Dutton	—	—	—	—	—	—	—	2.0	2.0
Statewide average	4.7	4.5	4.4	4.3	4.6	4.6	4.5	4.0	4.4

*Combined hunts: Box Elder Peak, Lone Peak, Timpanogos

Table 5. Resident and nonresident drawing odds of obtaining mountain goat hunting permits, Utah 1998–2017.

Year	Residents			Nonresidents		
	Applicants	Permits	Odds	Applicants	Permits	Odds
1998	568	18	1 in 31.6	44	1	1 in 44
1999	748	20	1 in 37.4	93	1	1 in 93
2000	904	24	1 in 37.7	142	2	1 in 71
2001	1103	27	1 in 40.9	194	2	1 in 97
2002	1505	33	1 in 45.6	244	2	1 in 122
2003	1793	37	1 in 48.5	275	3	1 in 92
2004	2072	40	1 in 51.8	333	3	1 in 111
2005	2384	59	1 in 40.4	464	5	1 in 93
2006	2747	83	1 in 33.1	660	6	1 in 110
2007	3351	84	1 in 39.9	683	5	1 in 137
2008	3405	83	1 in 41.0	732	7	1 in 105
2009	3577	91	1 in 39.3	2869	9	1 in 319
2010	3911	97	1 in 40.3	3194	10	1 in 319
2011	4005	118	1 in 33.9	3446	11	1 in 313
2012	4220	144	1 in 29.3	3779	17	1 in 222
2013	4620	144	1 in 32.1	4134	14	1 in 295
2014	5113	92	1 in 55.6	4599	10	1 in 459
2015	5492	93	1 in 59.1	5108	10	1 in 510
2016	5860	90	1 in 65.1	5497	8	1 in 687
2017	6441	94	1 in 68.5	6216	10	1 in 621

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Appendix A

MOUNTAIN GOATS IN UTAH: AN OVERVIEW

History

The mountain goat of western North America is one of two known members from the genus *Oreamnos*. The other member of the genus, *Oreamnos harringtoni*, is extinct. The closest extant relative is the chamois of Europe. Because of the harsh sites that mountain goats inhabit, the fossil record is not extensive. The genus likely derived from parent stock in Asia and entered North America sometime during the Pleistocene. It was likely completely isolated from that parent stock by the late Pleistocene (18,000 years ago).

During and since the Pleistocene, the distribution and status of goat populations likely varied widely since mountain goats specialized to occupy a narrow range of habitats. These habitats are tied closely to alpine cliffs, which means any glacial encroachment or retreat would have likely changed habitat suitability on all mountain ranges in western North America. This would have also caused an altitudinal shift in habitats within individual mountain ranges. During the full glacial period of the late Pleistocene, Harrington's mountain goats were present farther south than any mountain goats live today. This is documented by fossils recovered from the San Josecito Cave site, in Nuevo Leon, Mexico, at an altitude of 2300 meters. There were likely no goats present in much of Canada and Alaska because suitable cliff sites were buried by glaciers. With the end of the Pleistocene and the associated glacial retreat, suitable habitats for mountain goats would have become available northward and upward from the southern terminus in Mexico. As these habitat changes progressed, Utah would have provided a major pathway for goat redistribution from south to north. The central mountain ranges of Utah, along with the Rocky Mountains of Colorado, would have provided appropriate habitats for goat redistribution in response to changing climate. A strong case can be made that Utah would have been intermediate between both extremes. Given the variety and extent of mountain ranges through the length of the state, habitat at some elevation could have been provided during most if not all of the Pleistocene, and evidence from fossil sites in nearby areas support that premise. Pleistocene goat remains have been identified from the Smith Creek Cave site on the Utah-Nevada border near Baker, Nevada; at three sites in the Laramie Mountains in southeastern Wyoming; and at Rampart Cave and the Stanton site along the Colorado River corridor in northern Arizona. As conditions became warmer and drier in the Intermountain region after the Pleistocene, a dramatic restructuring of goat distributions could have occurred.

Recent Distribution

The distribution of mountain goats at the time of European contact with western mountain ranges is very poorly documented. This is likely a byproduct of the remote habitats used by mountain goats. Given the climatic conditions of the past 200 years, goat habitat would have been limited to the highest and most inaccessible alpine expanses in the Intermountain region. Only in Alaska and Northwest Canada would goats have been found near the valleys and basins that provided access for Europeans. Even early trappers would have been unlikely to encounter goats in their normal pursuit of beaver, since goats persist yearlong at high elevations in most ranges.

By the early part of the 20th century, European settlement and an interest in wildlife had set the stage for increasing recorded knowledge of the status and distribution of goats. By mid-century,

a well-documented analysis of goat distributions had emerged. A USFS report that was published in the Twelfth Biennial Report of the Fish and Game Commissioner of the State of Utah in 1917-1918, estimated 25 mountain goats on the Wasatch Forest. This figure was listed in addition to mountain sheep numbers. The Wasatch Forest at that time also included the Uinta Mountains; site locations, unfortunately, were not listed. A separate report from a District Ranger in Kamas stated that both mountain sheep and goats were present in the High Uintas. By the middle of the 20th century no native goat populations were known to persist in Utah, Colorado, Nevada, or Wyoming.

Currently, however, there are populations of mountain goats in all these states. All are the result of introductions of goats by state wildlife departments during the last 50+ years. Many, if not all, of these populations are healthy and viable, indicating that these populations all occupy habitat suitable for mountain goats. The status of these areas at the time of European settlement is not fully known.

The Intermountain Region Since the Pleistocene

The most recent glacial age ended about 14,000 years ago, and the interglacial period that we currently occupy had gained primacy. Conditions became significantly warmer and in many cases drier. Mountain goat habitat, which once existed as far south as Mexico was no longer suitable. The progression from full glacial advance to present day conditions was far from linear. Small scale returns to colder and snowier conditions occurred as recently as the 1800's. During the Middle Holocene, there was a period of several thousand years (from about 7,000 to 4,500 years ago) when climatic conditions were substantially warmer and probably drier than those today. Data indicate this period was pervasive enough that the Great Salt Lake may have been nearly dry.

Based on our knowledge of goat habitat requirements and climatic conditions in the early Holocene, goats could have found suitable habitat in many mountain ranges of Utah and the Intermountain area after the end of glaciation. These habitats were likely similar to those present today, though perhaps more extensive, given the cooler temperatures. During the Middle Holocene, however, the dramatic warming would have shifted goat habitat much higher on occupied mountain ranges. Data from the Snowbird Bog pollen sites indicate that timberline may have been 1000 feet or more higher in altitude than that found today. Given the observed altitudinal depth of current habitats, this compression would have eliminated suitable sites on most Intermountain ranges, and restricted those found in larger and more northerly ranges. Thus goat populations surviving after the Pleistocene in high elevation habitats may have been eliminated or restricted.

Since that period, however, conditions have reverted to a cooler and wetter pattern. Suitable goat habitat exists on many mountain ranges in Utah and surrounding states, as demonstrated by the survival of transplanted populations. If these ranges were devoid of goats at the time of European contact, why had goats not re-colonized there? Certainly goat populations had followed the ebb and flow of glacial periods for perhaps millions of years. However, one new factor was inserted at the end of the Pleistocene; humans. Humans became for the first time a member of the North American ecosystem. After that time, aboriginal people were widespread and important modifiers of both vegetative and animal communities. Although the extent and type of modifications are debated, the conclusion of nearly all recent research has been that impacts by aboriginal people were greater than previously thought. Some of the most obvious

and dramatic impacts would have been extensive and widespread burning, transportation of propagules of plant species beyond the range of "natural" movement, and manipulation or even elimination of populations and even species of large vertebrates.

It is known that goats were contemporaneous with aboriginal hunters at the end of the Pleistocene. The loss of goats during the Holocene may have been directly aided by opportunistic hunting of goats. It is well documented that native peoples hunted mountain sheep in alpine areas throughout the Intermountain area. Goats would have been an appropriate alternative prey item for these big game hunters.

Whatever the extent of this aboriginal pressure, it is obvious that recolonization of suitable habitats by goats had to be accomplished through the barrier of a thriving culture of big game hunters. These big game hunters likely only killed goats opportunistically, since their survival was dependent upon the vast array of other ungulates available to them. Given their highly selective habitat requirements, relatively low densities, and low fecundity, it would have been difficult for goats to recolonize these now suitable habitats. Currently, with a vast ocean of human habitation surrounding islands of goat habitat, the prospects for natural expansion of goat populations, except for unoccupied habitats immediately adjacent to existing populations, is unlikely.

An interesting footnote to this scenario can be added for the current status of moose. This species has since the turn of the century greatly extended its range southward into the Intermountain Area. The prospects for moose pioneering after the Pleistocene should have been as poor as for goats in the face of a thriving big game hunting culture. However, the encroachment of Europeans eliminated the two prime predators of moose - wolves and aboriginal big game hunters. After the turn of the century, wildlife laws and enforcement reduced the killing of moose by early settlers. As such, moose, with their higher mobility and broader habitat requirements than mountain goats, were able to colonize areas far to the south of what had been considered its historically occupied range.

Oreamnos speciation

The relationship between the two known species of *Oreamnos* (Harrington's goat and mountain goat) warrants some discussion. Essentially, the largest difference between the two species is size. Harrington's goat is up to 30% smaller than the existing mountain goat species and has minor skull variances. This difference is derived from skulls from a few well-documented sites in Arizona, Mexico, California, and Nevada. Overall, though, the fossil record is poor because of the low probability of preservation in the harsh sites frequented by goats. The existing fossils all came from protected cave sites which are rare. Nearly all such sites are from isolated areas at the southern extreme of past mountain goat range and were likely in areas isolated from other goat populations after the end of the Pleistocene. Caution must be exercised in projecting the importance of a character such as relative size in assessing its evolutionary significance and the relationship between the two *Oreamnos* species. Body size may be one of the most labile of morphological traits, especially in extremes of climatic conditions. Purdue and Reity (1993) have demonstrated tremendous shifts in body size in white-tailed deer during the past 4,400 years in Georgia and South Carolina. They consider climate changes with resultant habitat quality to be the driving factor for this change. They indicate that body size tends to be quite responsive to changes in certain environmental factors that in turn serve as the ultimate source of

selection. This is dramatically demonstrated by ungulates on islands, which may frequently be dwarfed in response to reduced food resources.

A careful consideration of these factors will generate caution in inferring about the relationship between *O. harringtoni* and *O. americanus*. The fossil records are non-existent between isolated southerly sites and the range of "modern" goats. It is possible that the Harrington population documented by cave sites were "islands" by the late Pleistocene. Kurten (1980) postulates that Harrington's goat was in fact an extension of *O. americanus* that became isolated at the end of the Pleistocene, and body size would have been driven by limited resources. Since their habits were probably like those of modern goats, they would have been subjected to resource limitations in their peripheral occurrences.

Appendix B

Notwithstanding the following list, any existing mountain goat populations can be augmented. All suitable mountain goat habitat within the following units/subunits will be considered for augmentation/reintroduction.

Potential mountain goat transplant sites by region, Utah 2018.[1]

Region	Unit	Transplant Site	Transplant Type
Central	Central Mountains	Loafer Mountain	Augmentation
	Central Mountains	Manti	Initial transplant
	Central Mountains	Mount Nebo	Augmentation
	Oquirrh-Stansbury	Stansbury Mountains	Initial transplant
	Wasatch Mountains	Box Elder Peak	Augmentation
	Wasatch Mountains	Lone Peak	Augmentation
	Wasatch Mountains	Provo Peak	Augmentation
	Wasatch Mountains	Timpanogos	Augmentation
	West Desert	Deep Creek Mountains	Initial transplant
Northeastern	North / South Slope	High Uintas Central	Augmentation
	North / South Slope	High Uintas East	Augmentation
	North / South Slope	High Uintas Liedy Peak	Augmentation
	North / South Slope	High Uintas West	Augmentation
Northern	Cache	Wellsville Mountains	Augmentation
	Cache	Logan Peak	Augmentation
	Cache	Mount Naomi	Augmentation
	Kamas	Uintas	Augmentation
	Ogden	Ogden Peak	Augmentation
	Ogden	Willard Peak	Augmentation
Southeastern	La Sal	La Sal Mountains	Augmentation
Southern	Beaver	Tushar Mountains	Augmentation
	Mt Dutton	Mt Dutton	Augmentation
	Monroe	Monroe	Initial transplant
	Panguitch Lake	Panguitch Lake	Initial transplant
	Plateau, Boulder	Boulder	Initial transplant
	Plateau, Thousand Lakes	Thousand Lakes	Initial transplant

[1] In accordance with Utah Code 23-14-21.