# 2024 RANGE-WIDE STATUS OF BIGHORN AND THINHORN SHEEP IN NORTH AMERICA

Wild Sheep Initiative. Western Association of Fish and Wildlife Agencies (ver. 07082024)

The purpose of this document is to provide a general overview of the current bighorn and thinhorn sheep population status and general abundance trends throughout their range in North America. The information reported is the harvest and population estimates after the 2023 hunting season. The Wild Sheep Initiative (WSI) consists of representatives from 20 state, territorial, and provincial agencies that comprise the Western Association of Fish and Wildlife Agencies (WAFWA).

The WSI's mission is to provide a collaborative approach to finding solutions to improve wild sheep conservation and management. The general population status and trajectory of wild sheep populations is commonly requested by stakeholders including agency leadership, NGOs, hunters, and the public at large. To provide a quick snapshot of the status of these species, the WSI assembled this information by having each agency representative provide the current population status, harvest information (Tables 1 – 3), and disease status/management for their respective jurisdiction for the period June 1, 2023 to May 31, 2024. All states and provinces use very different methods to survey and estimate population size and harvest. Some have more rigorous processes than others, based on available resources and management needs within their jurisdictions. Wild sheep populations are below agency goals in most jurisdictions, due to a variety of factors of which disease, primarily pneumonia, harsh winter conditions, and climate are perhaps the most important. Wildlife managers, veterinarians, and researchers have been tirelessly seeking solutions to population decline with some success.
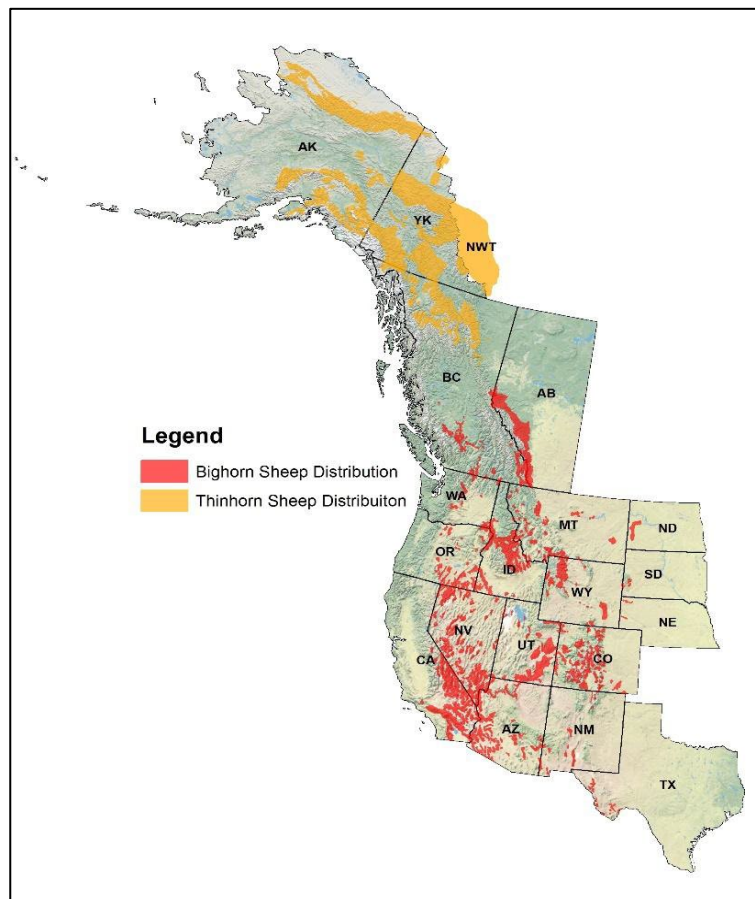
Bighorn sheep (Rocky Mountain and California BHS – Table 1 and Desert BHS – Table 2) populations are generally stable with a recent downward trend across most jurisdictions (Figure 1), however, British Columbia is reporting significant declines in California BHS populations through the past 5 years.

Thinhorn sheep population status data is incomplete. In Alaska, managers estimate that Dall's sheep have been stable with a recent dramatic, sharp decline due to extraordinarily harsh winter conditions. In British Columbia, Dall's sheep have been stable, but estimates were increased in 2019 as a result of new genetic information that expanded the range of that subspecies to include areas previously identified as Stone's sheep (Table 3, Figure 2). Stone's sheep estimates from British Columbia show a similar trend over the past 23 years with a modest decline in 2020 (Table 3, Figure 2).

Table 1. Range-wide estimates of 2023 bighorn sheep (Rocky Mountain and California BHS combined) population size, number of hunting licenses issued, and number of rams and ewes harvested. **Click on a state/province/territory name to go directly to that jurisdiction.**

	Estimated Population	Ram Licenses	Ram Harvest	Ewe Licenses	Ewe Harvest
Alberta	6,000	2,482[1]	199	173	62
Arizona	1,300	19	19	n/a	n/a
British Columbia[2]	4,250	179	n/a	7	n/a
California	n/a	n/a	n/a	n/a	n/a
Colorado	7,000	250	174	91	58
Idaho	3,400	96	78	0	n/a
Montana	4,748	120[3]	132[4]	77	31
Nebraska	215	2	2	0	0
Nevada	2,000	41	31	0	0
New Mexico	1,565	28	27	30	30
North Dakota	490	6	6	0	n/a
Oregon	5,500	79[5]	71	22	8
South Dakota	335	11	11	0	0
Utah	1,646	63	60	5	4
Washington	1600	25	25	28	25
Wyoming	6,987	186	154	50	28

[1]*Alberta – Includes licenses allocated to outfitters, and general and special (limited entry hunt) licenses sold to Alberta residents.*

[2]*British Columbia – data listed under licenses includes only the numbers of available draws/permits issued in Limited Entry Hunt Zones*

[3]*Limited entry hunt units only*

[4]*Montana – includes limited and unlimited hunting district ram harvest*

[5]*Includes controlled hunts, 1 auction tag, and 1 raffle tag.*
n/a – not available

Table 2. Range-wide estimation of 2023 Desert bighorn sheep population size, licenses issued, and rams harvested. **Click on a state/province/territory name to go directly to that jurisdiction.**

	Estimated Population	Ram Licenses	Ram Harvest	Ewe Licenses	Ewe Harvest
Arizona	5,600	137	131	n/a	n/a
California	4,500	26	20	n/a	n/a
Colorado	500	15	14	0	0
Nevada	7,100	240[1]	193	90	44
New Mexico	1,168	29	29	0	0
Texas	530	4	2[2]	0	0
Utah	3,273	85	75	0	0

[1] *Total ram tags including management ram hunt for one-horn ram*

[2] *Two outstanding tags at time of print; hunt season ends 31 July.*

n/a – not available

Table 3. Range-wide estimation of 2023 Thinhorn sheep (Dall's sheep and Stone's sheep) population size, licenses issued, and rams harvested. **Click on a state/province/territory name to go directly to that jurisdiction.**

	Estimated Population	Ram Licenses	Ram Harvest	Ewe Licenses	Ewe Harvest
Dall's sheep					
Alaska	Decline	4,147	424	0	0
British Columbia[1]	700	46	n/a	0	0
NW Territories	n/a	n/a	n/a	n/a	n/a
Yukon	22,500	1742	225	0	0
Stone's sheep					
British Columbia	12,300	112	n/a	0	0
Yukon	100	n/a	n/a	n/a	n/a

[1]*British Columbia – data listed under licenses includes only the numbers of available draws/permits issued in Limited Entry Hunt Zones*

n/a – not available

Figure 1. Bighorn sheep population trend throughout North America, 2000 – 2023.
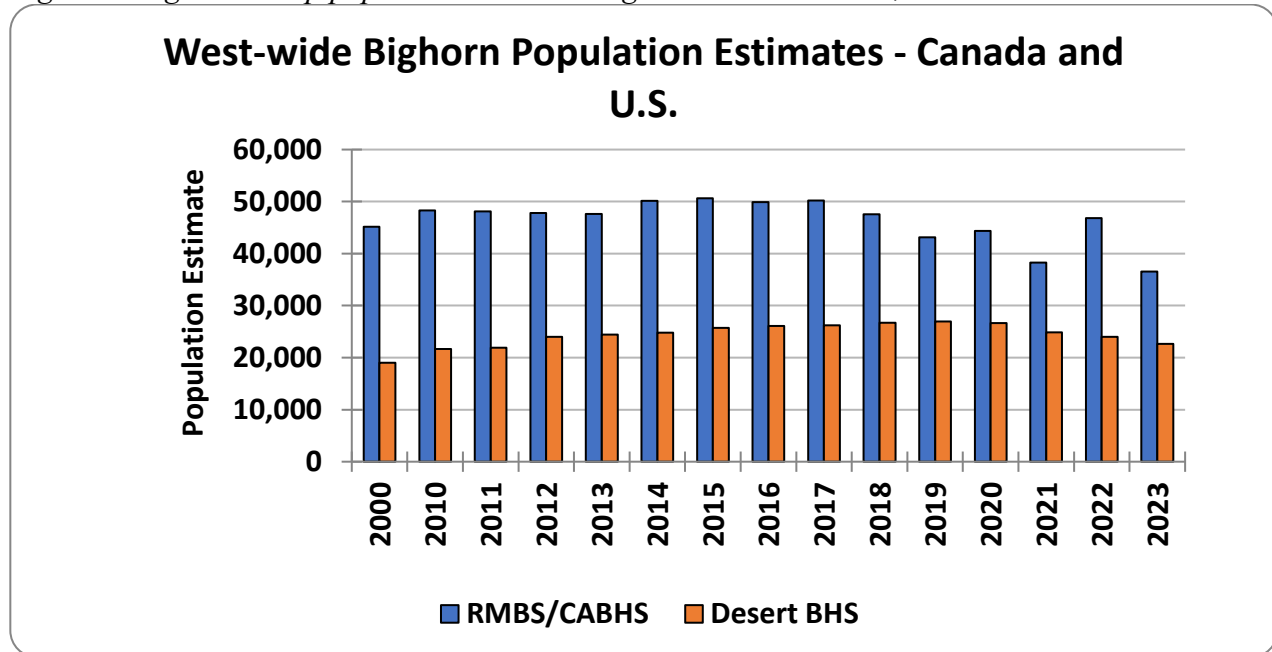
Figure 2. Thinhorn sheep population trend in British Columbia and Yukon, 2000 – 2023.
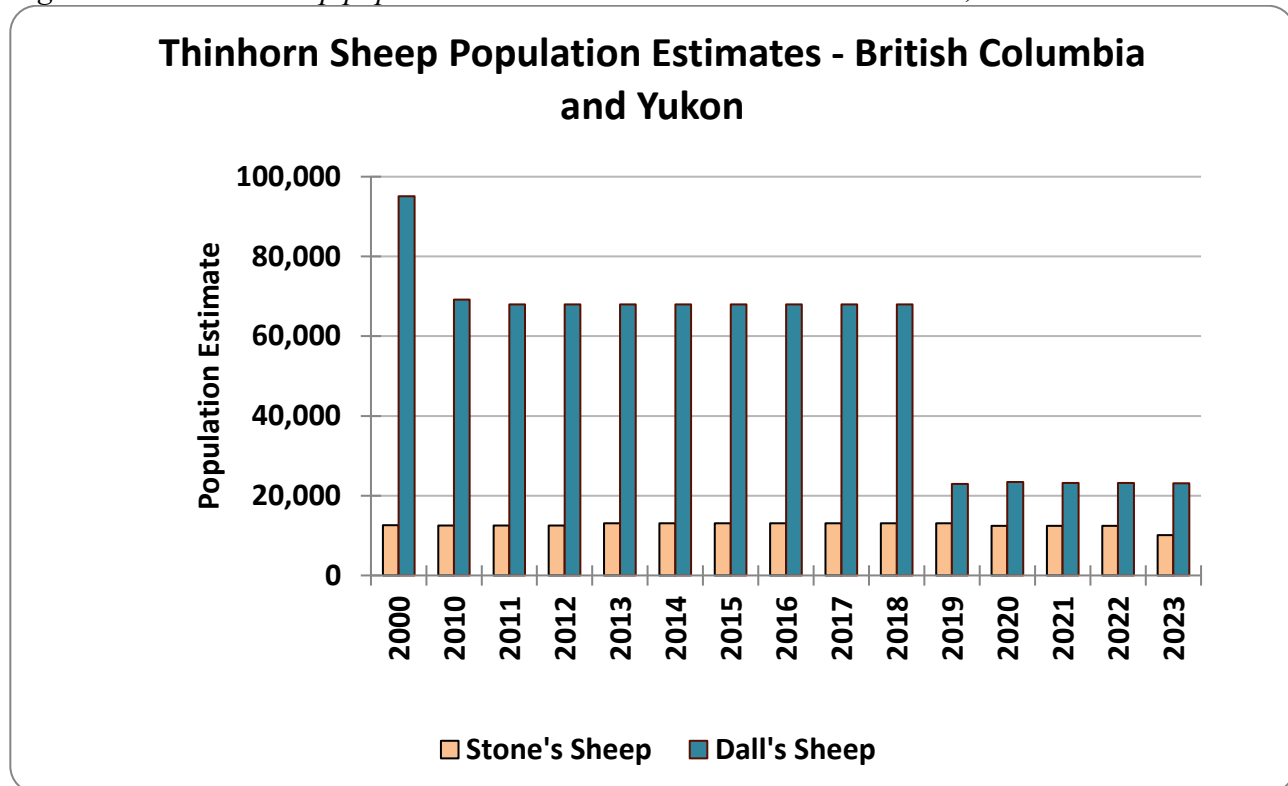
As sheep numbers decline, license availability and harvest follow suit. Even though license issuance for Dall's sheep decline by 56% in 2023 compared to the recent high in 2017, this species continued to provide the majority of wild sheep hunting opportunity based on license issuance. On average, over the last 10 years:

  ➢ Dall's sheep, bighorn sheep (Rocky Mountain and California), desert bighorn sheep, and Stone's

sheep account for 62%, 32%, 5%, and 1% of wild sheep hunting licenses available, respectively (Figure 3).
➢ Harvest of bighorn sheep (Rocky Mountain and California) and Dall's sheep was the highest at 40% and 34%, respectively.
➢ Harvest of desert bighorn sheep and Stone's sheep accounted for 20% and 6%, respectively (Figure 4).

Figure 3. Thinhorn and bighorn ram licenses across Canada and U.S., 2000 – 2023.
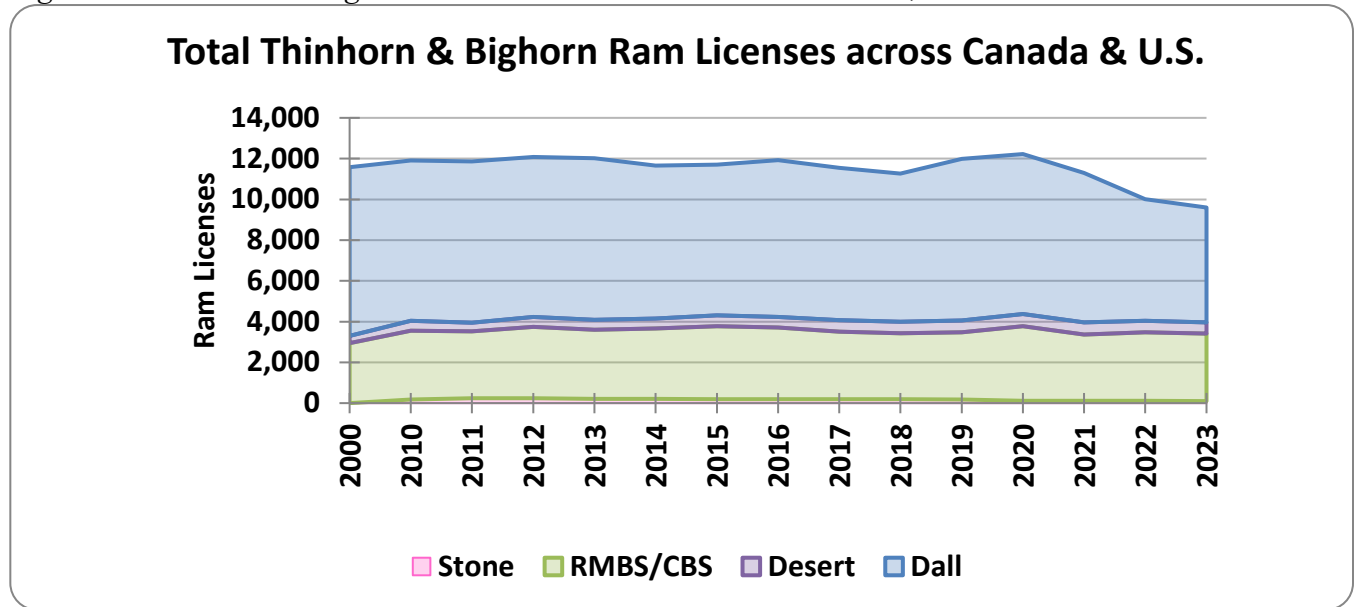
Figure 4. Total ram harvest across all wild sheep jurisdictions, 2000 – 2023
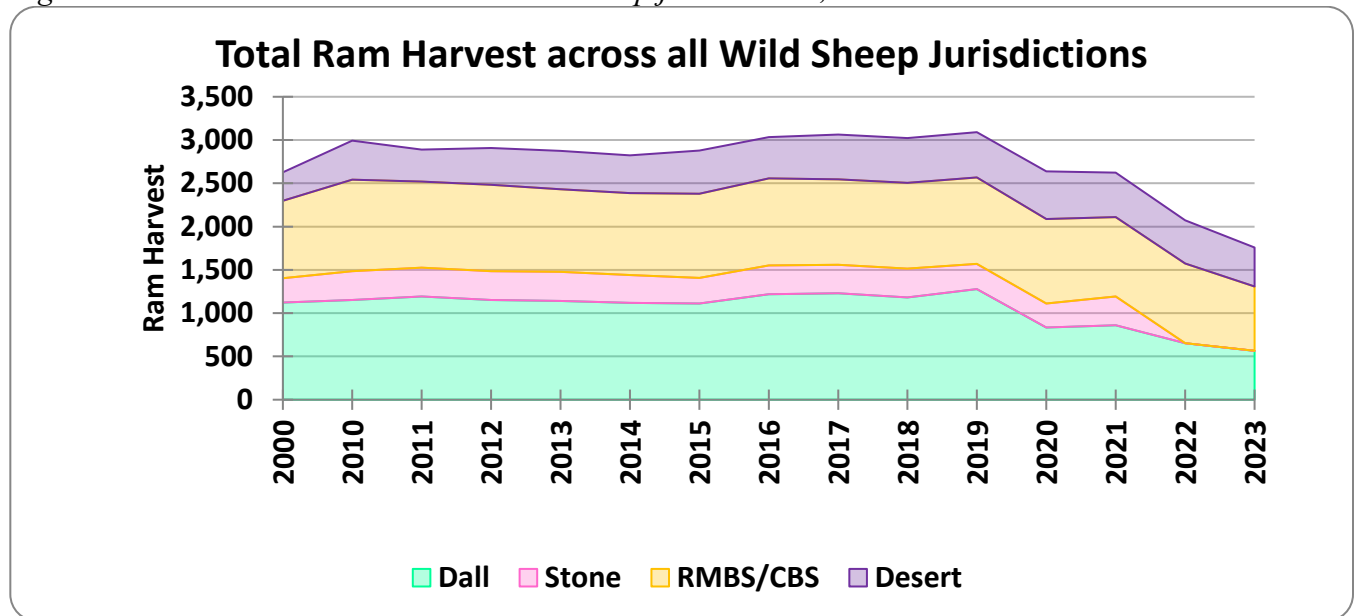
State/Provincial Status Reports

Alaska
Dall's Sheep
Populations

Dall's sheep populations inhabit 8 mountain ranges in Alaska (Figure 1). Populations are found through a mosaic of State, Federal and Native Lands. Throughout most of the state, managers have established minimum count areas for sheep. These areas are necessarily small, relative to the geographic scale of an entire game management unit. Data are not corrected for snow cover, shadows, sun angle, observer experience, or any one of several things that can affect how many animals are observed. Therefore, these minimum count surveys serve as a relative population index and are in no way a measure of absolute abundance. However, throughout the state sheep numbers have declined 40-70% from the most recent highs ca 2010. These declines are reported on both hunted and unhunted (e.g. National Park Service) lands, which strongly suggests that extreme weather events and not current harvest strategies are contributing to the current poor population performance.

Figure 1. Alaska Dall's sheep populations.
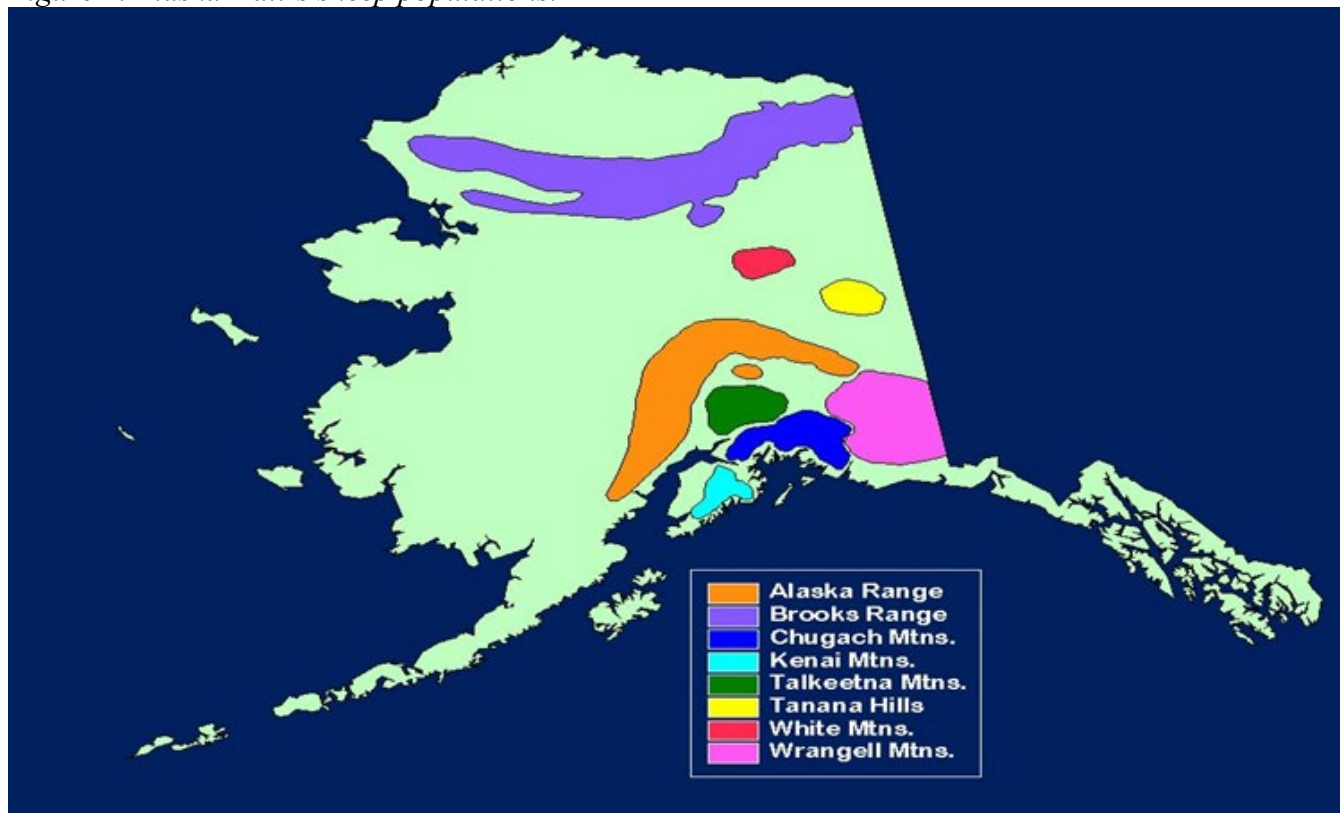
Alaskan sheep population declines are at least partially explained by a combination of poor lamb production and high adult mortality in several years between 2012 and present. Record winter snowfall in 2011-2012 and near-record levels again in 2012-2013 were accompanied by record low population pregnancy rates in those and following years. Indeed, it is hypothesized that in many cases, extreme winter conditions result in a carryover effect where low pregnancy rates and poor body condition persist for at least an additional year after stressful conditions are experienced. These effects were not limited to that two-year time frame: between 2009-2022, most female sheep handled and sampled in the Chugach and Talkeetna mountain ranges evidenced extremely poor body condition (1 -1.5 on a 0-6 scale).

Population pregnancy rates varied greatly from lows in the range of 18, 21, and 44% in some years up to as high as 96% in others (ADFG, 2022). For reference, most healthy ungulate populations see consistent pregnancy rates of 85-100% in adult females.

Poor lamb production during 2012-2014 was also exacerbated by poor adult survival between 2019-2022. Although mortality curves for Dall's sheep have been published by multiple researchers, in general mortality is low for sheep ages 2-8. However, overwinter mortality rates were much greater than expected during those three winters. In the winter of 2019-2020, 34% of all radio collared sheep in the Talkeetna mountains died from a variety of causes ranging from avalanches, predation, disease, falls, and malnutrition. During the winter of 2020-2021, and 2021-2022, 19% and 29%, respectively, of all monitored adult sheep, in the Talkeetnas also died from the same causes (ADFG, 2022). In comparison, data from radio collared sheep in the Chugach, Wrangell, and Talkeetna mountains between 2008-2019 show that in most winters, overall adult survival rates are between 88-92%. This is similar to what Arthur reported in his Brooks Range (77-88%) (Arthur, 2013) and Alaska Range (85%) research projects (Arthur 2003).

Poor lamb production and overwinter survival was not limited to populations south of the Alaska Range, as declines of similar magnitude were noted in aerial surveys in other game management units and on National Park Service lands; Rattenbury et al. (2018) reported that lamb production was negatively related to the annual timing of the end of the CSS (continuous snow season) and was near zero in arctic areas in 2013. The 2013 event was also associated with ~40–70% declines in overall sheep numbers in arctic areas, indicating adult survival was also impacted.

That said, population cycles have occurred before. In Murie's book, *The Wolves of Mount Mckinley* (1944), they speak of robust sheep numbers in the park until a drastic die off associated with heavy snowfalls in the late 1920's and into the early 1930's. A more contemporary example is observed in GMU 20A (Figure 2). Sheep populations and harvest in this GMU was high until a weather-related population decline during the winter of 1992-1993. Managers chose to keep this hunt structured as general harvest open to both residents and nonresidents. Although it took on the order of 15-20 years to rebuild, sheep populations and harvest returned to pre-decline levels, peaking in 2016 until the recent population decline.

There is concern that with a warming environment in Alaska we may be witnessing a paradigm shift in Dall's sheep densities. The Arctic is warming at twice the rate of lower latitudes, temperatures are predicted to rise by 3–6°C by 2080 (5-11F) (Callaghan et al. 2004, Olsen et al. 2011). Recently published literature suggests that adult sheep survival is negatively associated with increased wintertime freeze-thaw events (Van de Kirk et al. 2020). Furthermore, there is evidence for increased "shrubification" in the alpine with warm temperatures which would decrease the amount of suitable habitat for Dall's sheep (Dial et al. 2016) leading to decreased carrying capacity in many ranges.

Licenses and Harvest

Throughout the State sheep are managed through a combination of General Season, Draw and registration hunts. For the most part the state operates under a general season, Full Curl harvest strategy, except for a small number of registration and limited entry drawing permit hunts that operate under alternate strategies such as any ram hunts. Harvest tickets for sheep were first issued in 1962. Between 1962 and 2023 the average number of sheep harvested each season has been 985 with a range of 336-1454. Harvest was between 700-800 for much of the 2000s but has declined substantially beginning in 2020, with 629 rams taken. Initial declines in 2020 were followed by further decreases in statewide harvest, with 487 rams taken in 2021, 424 in 2022 and 336 reported to date during the 2023 season (Figure 3). Comparing current harvest to the long-term average is confounded because: 1) early harvest happened before ANILCA, thus

more area was open to hunting, 2) some areas have gone from general harvest to draw hunt, thus limiting opportunity, and 3) hunter participation has decreased. Between 1980 – 2000 there was an average of 3,097 sheep hunters per year, and between 2001-2022 there was an average of 2,489 hunters per year (Figure 4). Harvest success rates were largely stable for both resident and non-resident hunters until the recent population declines (Figure 5).

Figure 2. Game management unit 20A, central Alaska Range, Alaska.
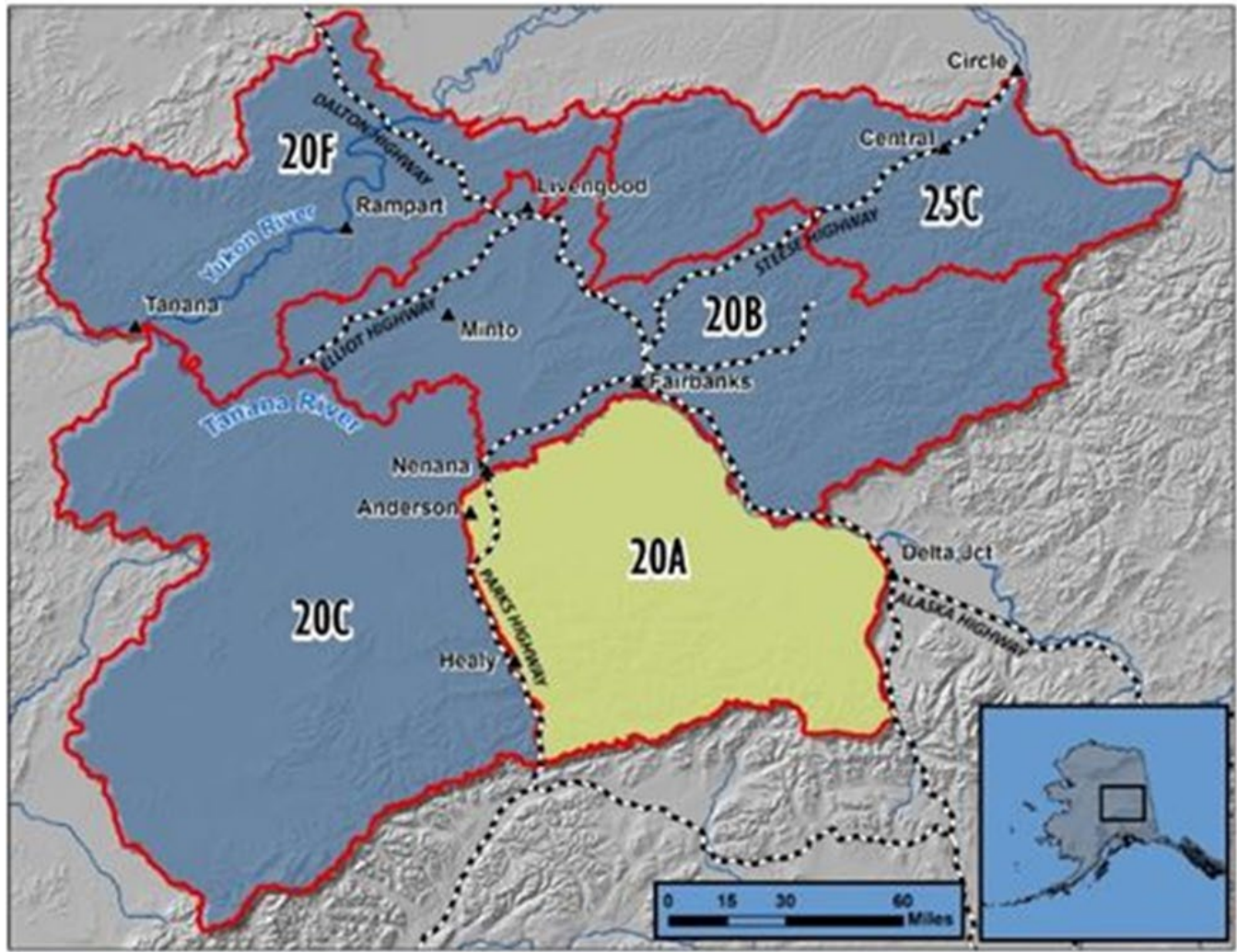
Disease and Herd Health

The state has active and/or upcoming research projects in the Brooks and Alaska Ranges, current research ongoing in the Chugach, and recently completed projects in the Talkeetna and Wrangell mountains. Traditional palpations are used to estimate body condition on most captured sheep. Blood, nasal and tonsil swab samples are collected by an ADF&G wildlife veterinarian or experienced personnel. Samples are handled, stored and analyzed at laboratories accordance with the WAFWA Wildlife Health Committee 2014 Bighorn Sheep Herd Health Monitoring Recommendations to assess Alaska/thin-horn sheep pathogens and parasites of concern and health biomarkers as determined by the Alaska Wildlife Health and Disease Surveillance Program veterinarian. A blood sample from any ewes handled in late winter is also collected to quantify pregnancy rates via PSPB analysis from serum and obtain individual DNA. Feces are collected and submitted for parasite analysis.

Surveillance for bacterial respiratory pathogens from hunter harvest and research samples identified bacterial DNA of *Mycoplasma ovipneumoniae* (M. Ovi) along with other mycoplasma species with close genetic relationships to M. ovi in healthy wildlife populations in Alaska (Lieske 2022). Of the areas surveyed, on multiple tests at multiple labs we have had positive detections of M. ovi presence in populations of Dall's sheep in the eastern Alaska Range, Talkeetna Mountains, and Wrangell Mountains, as well as Fortymile and Nelchina caribou, and we have had M. ovi detections in other areas and species on at least one test. Importantly, there may not be cross immunity for different genetic types so the presence of M. ovi in wildlife doesn't mean they are 'safe' or immune to 'new' types. Currently, ADF&G does not believe that wildlife populations are in danger due to M. ovi genetic types currently in Alaska's wildlife.

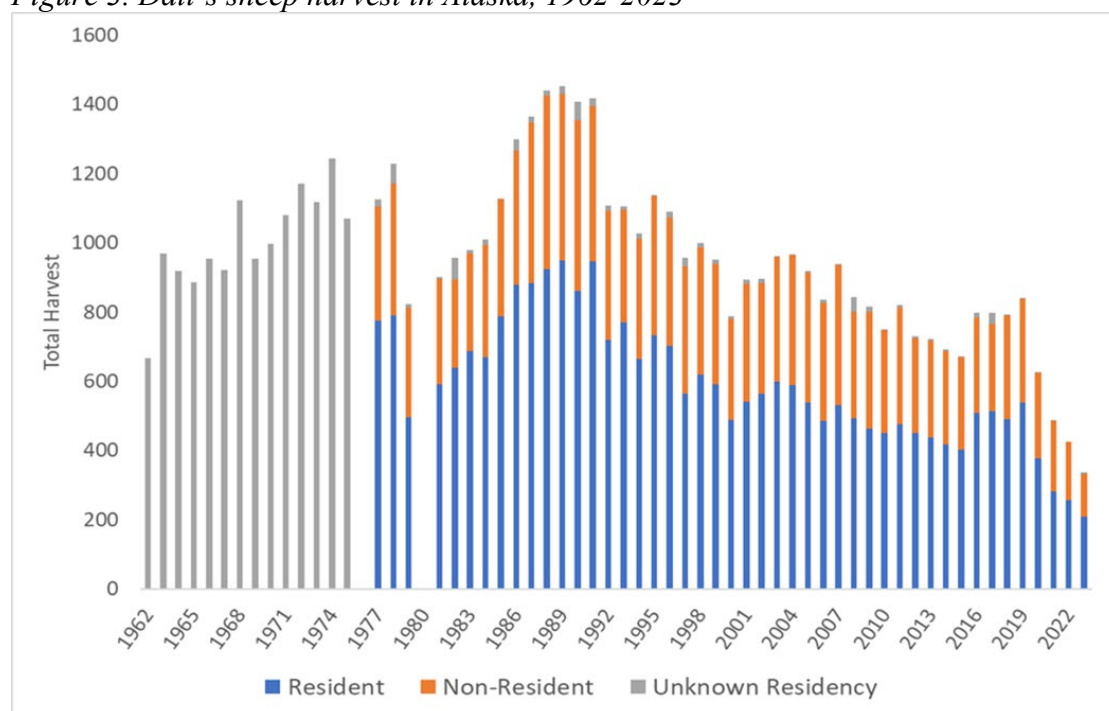*Figure 3. Dall's sheep harvest in Alaska, 1962-2023*

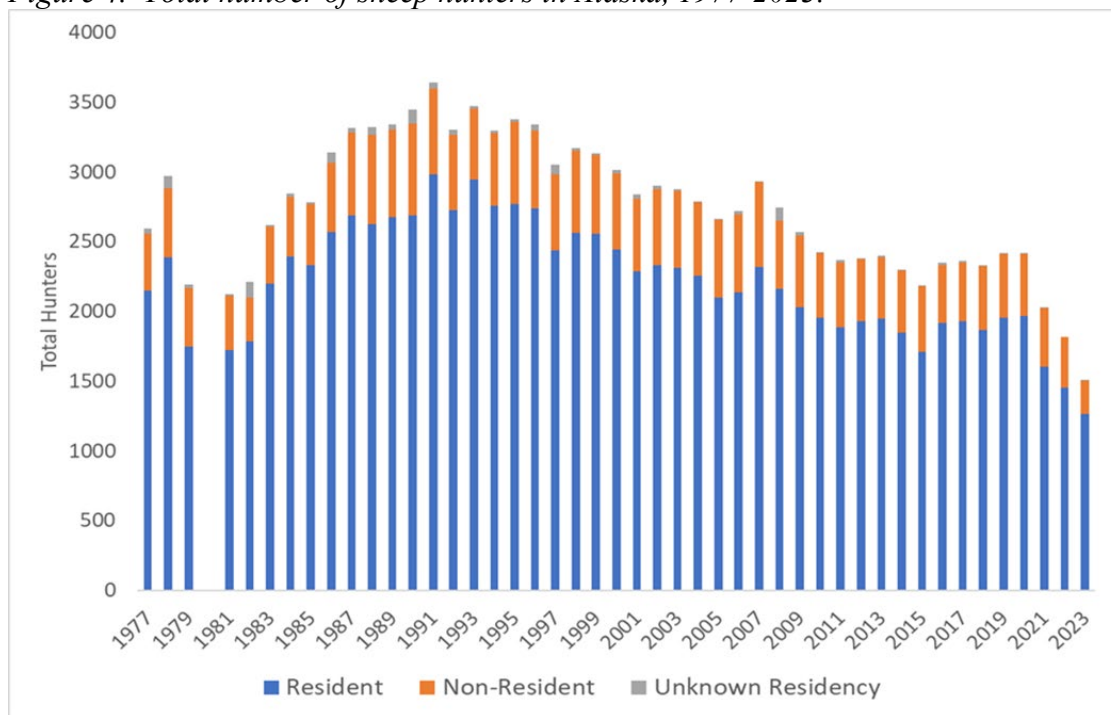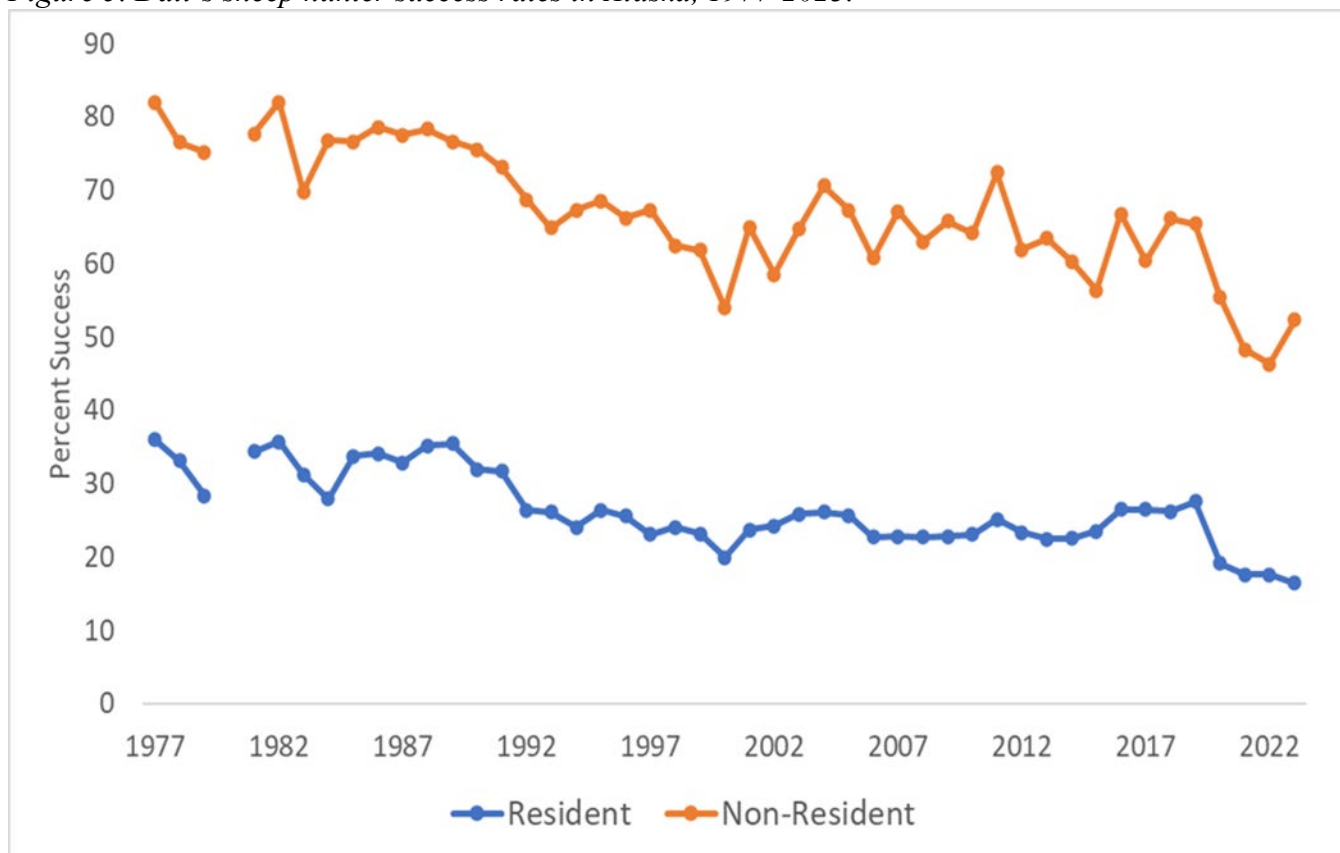*Figure 4. Total number of sheep hunters in Alaska, 1977-2023.*

Figure 5. Dall's sheep hunter success rates in Alaska, 1977-2023.

Test and Remove

There are no test and remove programs in the State of Alaska.

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Alberta

Rocky Mountain Bighorn Sheep (RMBHS)

Populations

There are an estimated 9,000 RMBHS in Alberta (2023), of which 6,000 occur on provincial lands and

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3,000 in federal National Parks. This estimate is based on minimum aerial survey counts every 2-5 years of known winter ranges. Overall, the provincial population has been stable to slightly decreasing since 2000.

Licenses and Harvest
To be legal for harvest, rams must meet or exceed a 4/5 curl ('Trophy Sheep') or full curl requirement ("Full-curl Trophy Sheep"). In 2022, there were 58 special licenses available to Alberta residents through a limited entry draw / lottery system, as well as 117 outfitter allocations. In addition, 2307 resident Albertans purchased a general license to hunt rams. This license provides an "over the counter" hunting opportunity (with 1 license/hunter and an unlimited number of licenses available).

In 2023, 148 rams were harvested by resident hunters, up from an average of 118 from 2020-2022. Overall, 199 rams were harvested in 2023 by all licensed hunters (resident, non-residents, non-resident aliens), consistent with past years.

Hunter success is typically 5% for resident hunters and approximately 40-50% for hunters accompanied by an outfitter. The ram harvest rate averages about 2.6% of the estimated population on provincial lands. Harvest in some sheep management areas exceeds 50-70% of available legal rams annually, with 70-90%+ of rams harvested the first year they become legal. The percentage of legal rams observed in aerial surveys in many areas has consistently been low (1-3%) the last 5 years or more.

Ewes, or male bighorn sheep < 1 year of age, can be hunted under a special license (limited entry hunt) in 27 non-trophy areas. These areas include 14 of a possible 31 wildlife management units (WMUs) with bighorn sheep. A total of 173 non-trophy sheep licenses were available in 2023, down slightly from the 2020-2022 average of 182. The non-trophy harvest rate averages about 1% of the estimated population on provincial lands.

Disease
Prior to February 2023, there had not been a known pneumonia outbreak in Alberta since 2000. In February 2023, 9 rams were found dead in the Sheep River Provincial Park west of Black Diamond in southern Alberta. An additional 7 rams were observed coughing and were culled by wildlife managers to prevent transmission to a nearby group of 95 bighorn ewes and young animals. Fourteen of the 16 rams tested positive for *Mycoplasma ovipneumoniae* (M. ovi). Of the remaining two rams, samples were unavailable for one and necropsy revealed that the other had severe respiratory pneumonia.

A subset of bighorn sheep in the adjacent herd of 95 were subsequently tested for *Mycoplasma* spp. and all 42 were negative. Eight young rams in this herd were also radio-collared to track their movements.

Anne Hubbs, Alberta Environment and Protected Areas

Arizona
Arizona has Rocky Mountain bighorn sheep and two sub-species of desert bighorn sheep, with the Nelson's (*Ovis canadensis nelsoni*) bighorn sheep occupying the northern areas of Arizona and the Mexican (*Ovis canadensis mexicana*) bighorn sheep occupying the central and southern habitat areas of the state.

Through aggressive translocation and augmentation efforts over the past couple of decades, Arizona has reached record high population numbers and distribution through native bighorn sheep range after

experiencing the same type of near-extirpation wildlife events that many western states witnessed in the early years of the twentieth century.

Since 1955, Arizona Game and Fish Department (Department) has captured and released ~1,397 desert bighorn sheep within and outside of the state establishing new herd units and augmenting existing herd units within identified native habitat. During this long-term effort, the Department has worked collaboratively with the Utah Division of Wildlife Resources to acquire desert bighorn sheep for conservation efforts. Arizona has also been the source population for augmentations in multiple locations within Colorado, New Mexico, Texas, and Utah, assisting with those state agencies management objectives.

Since 1979, the Department has released ~160 Rocky Mountain bighorn sheep within the state establishing new herd units and/or augmenting existing herd units and has worked collaboratively with Colorado and New Mexico to acquire bighorn sheep in the past. Most recently, in November 2022 the Department collaborated again with the Utah Division of Wildlife Resources and supplied 27 Rocky Mountain bighorn sheep for release on Antelope Island, Utah.

Rocky Mountain Bighorn Sheep
Populations
Rocky Mountain bighorn sheep populations throughout Arizona have increased since the late 2000s, primarily a result of translocations of "nuisance or at-risk" bighorn sheep within private land and mining operations in the eastern portion of the state. Several new herd groups have been established in Arizona native range, as well as providing a source population for other western state agencies to further conservation and recovery efforts. The current Rocky Mountain bighorn sheep population is estimated at 1,300 bighorn sheep.

Figure 1. Historic Survey Ram and Lamb Ratios from Survey Data – Rocky Mountain Bighorn Sheep.
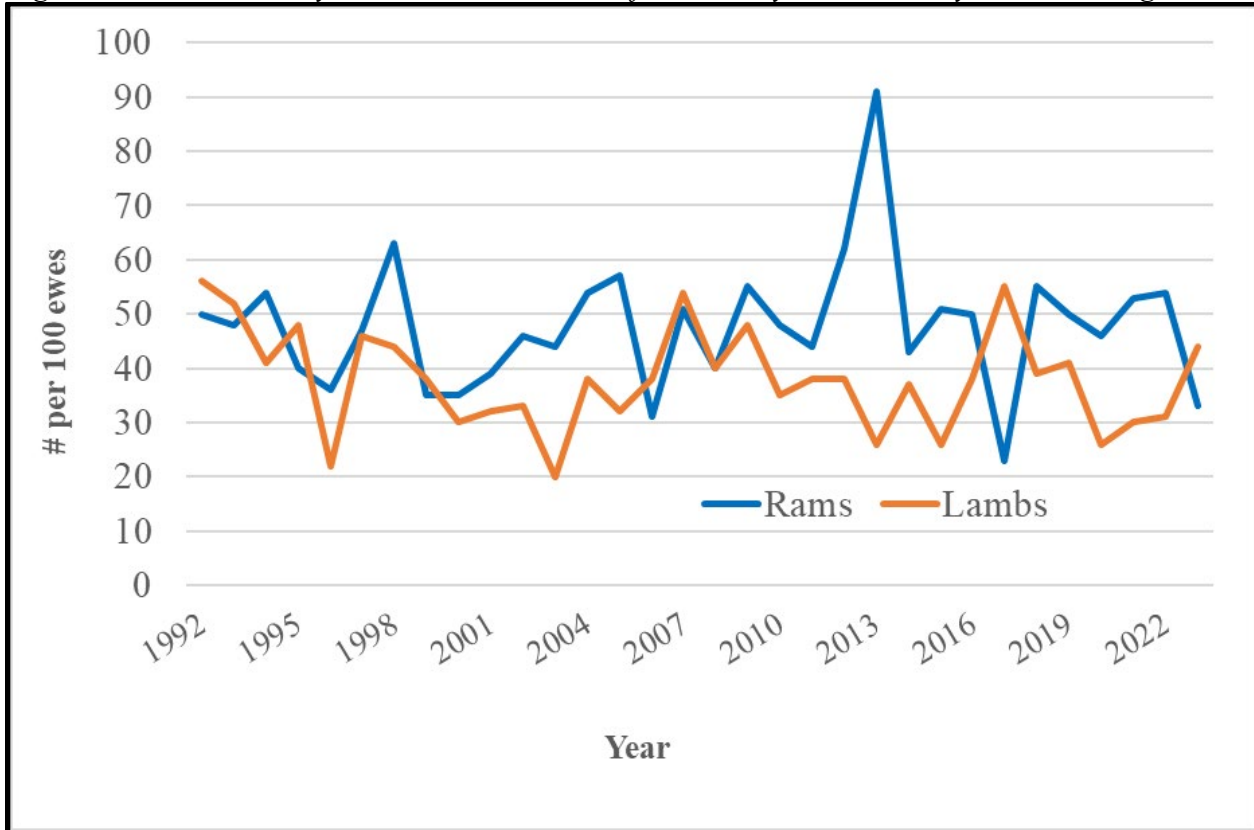
Licenses and Harvest
The number of hunt permit-tag licenses offered, as established within the Department's Hunt Guidelines, is set at 15-25% of the estimated number of Class III (age 6-8 years old) and Class IV (age 8+ years old) rams determined through survey observations and population modeling.

During the 2023 hunt season, 19 "Any-Ram" hunt permit-tags were offered. There was a total of 5,177 first choice applicants in the hunt draw process, which is a hybrid, bonus-point type draw system. Eighteen (18) mature rams were harvested, plus one (1) additional ram was taken under the Commissioner's Special-Tag statewide permit. The average age of the Rocky Mountain bighorn sheep rams harvested during the 2023 seasons was 8 years old with an average score of 169.

The Arizona Game and Fish Commission has not yet approved permit-tags for Rocky Mountain bighorn sheep for the 2024 hunt seasons, but a similar number of permits is anticipated.

Disease and Herd Health
Biological samples are taken during capture efforts (includes collaring for population monitoring and/or translocations). We have sampled 2 different game management units/populations (Morenci, Gisela). No M. ovi has been detected.

Test and Remove
No test and remove efforts have been implemented to date. However, this management tool will be considered in response to any documented disease outbreaks in populations that may be conducive and receptive to a test and remove effort.

Figure 2. Rocky Mountain Bighorn Sheep Hunt Data.
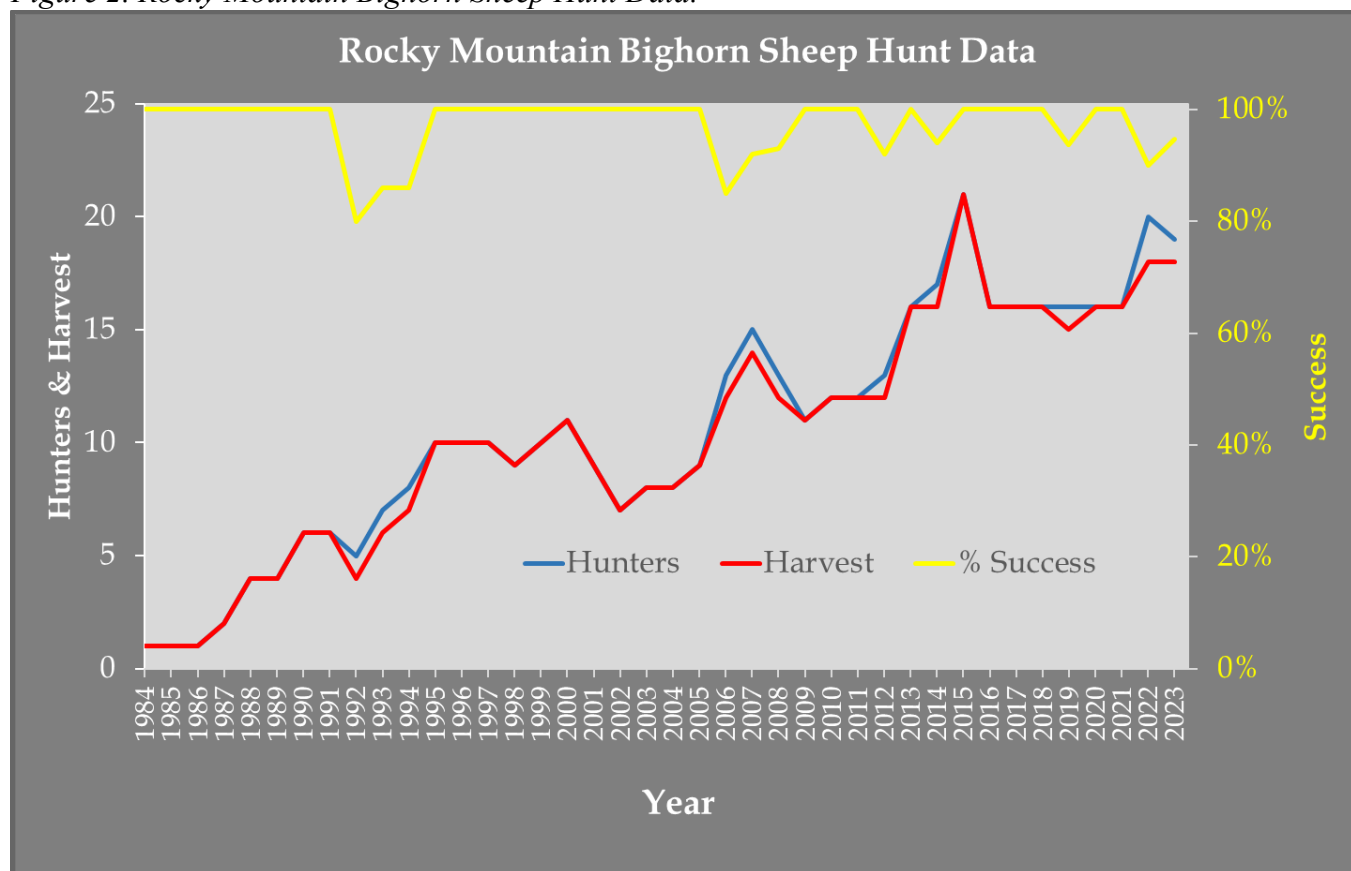
Desert Bighorn Sheep

Populations

Desert bighorn sheep populations throughout Arizona have shown variability in population estimates as management units are typically only surveyed once every three years in most occupied habitat. Overall, populations have increased statewide. Currently, the statewide population is estimated to be approaching 5,600 bighorn sheep. A large portion of the documented increase is in the Kofa Mountains and adjacent mountain ranges in western Arizona. The Kofa National Wildlife Refuge population has increased from a total estimated population of 404 in 2012 to an estimated 941 bighorn sheep based on the 2021 aerial survey.

Licenses and Harvest

The number of hunt permit-tag licenses offered, as established in the Department's Hunt Guidelines, is set at 15-25% of the estimated number of Class III (age 6-8 years old) and Class IV (age 8+ years old) rams determined through survey observations and population modeling.

During the 2023 hunt season, 137 "Any-Ram" hunt permit-tags were offered. There were a total of 22,055 first choice applicants in the hunt draw process, which is a hybrid, bonus-point type draw system. There were 131 desert bighorn sheep rams harvested in 2023 regular seasons, plus two (2) additional rams taken under the Commissioner's Special-Tag permits. The average age of the desert bighorn sheep rams harvested during the 2023 seasons was 8 years old with an average score of 161.

The Arizona Game and Fish Commission has not yet approved permit-tags for desert bighorn sheep for

the 2024 hunt seasons, but a similar number of permits is anticipated.

Figure 3. Historic Ram and Lamb Ratios from Survey Data – Desert Bighorn Sheep.
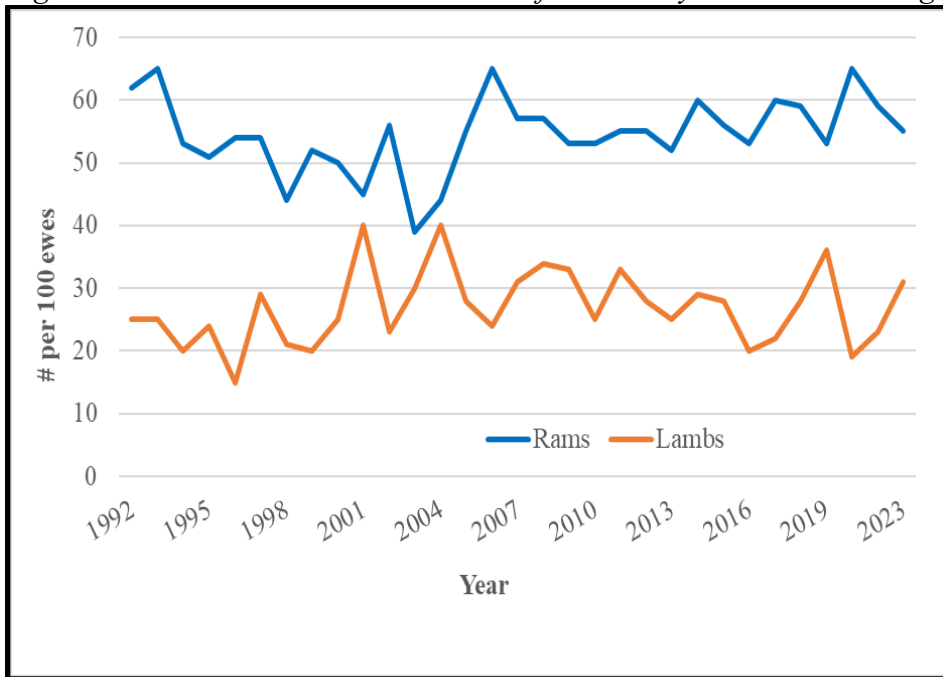
Figure 4. Desert Bighorn Sheep Hunt Data.
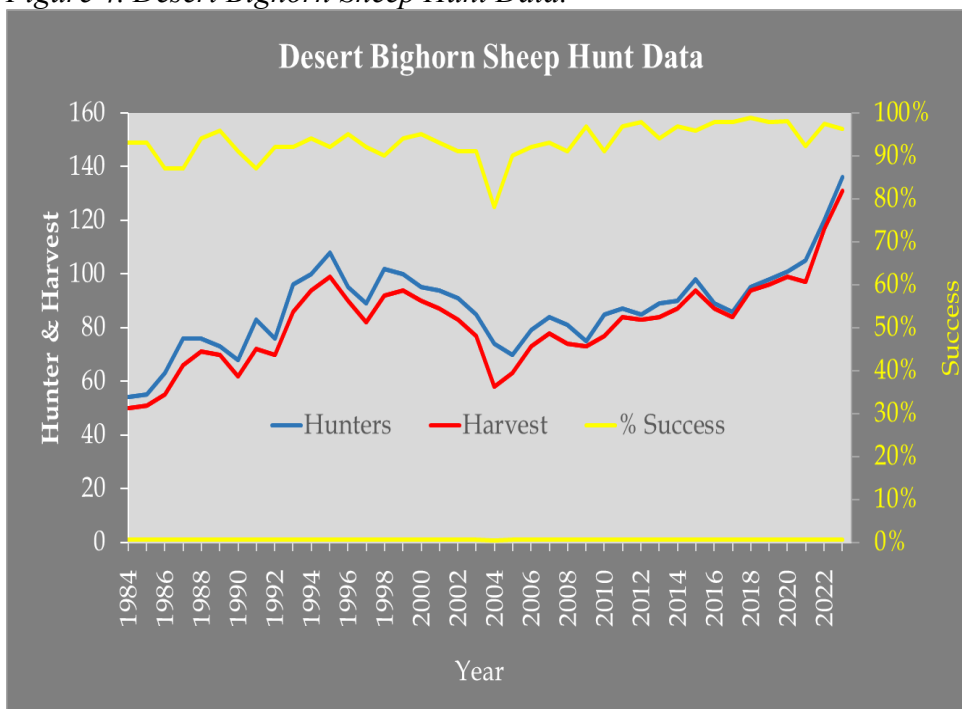
Disease and Herd Health

Biological samples (nasal swabs) were collected during the mandatory check-out process from hunter harvested bighorn sheep (N=51) and strain typing is pending for those samples testing positive for pneumonia. Preliminary positive samples were from management units 15C, 15D, 39W, 44B, and 46B.

Biological samples were taken during capture efforts (includes collaring for population monitoring and/or translocations) in the following desert bighorn sheep management units (Tables 2, 3, 4).

Table 2: Serology results for bighorn sheep in FY20 expressed as number testing positive (%positive). Antibodies for bluetongue (BTV), bovine respiratory syncytial virus (BRSV), epizootic hemorrhagic disease virus (EHDV), Parainfluenza 3, and Mycoplasma ovipneumoniae (M. ovi) were detected. PCR was performed to detect M. ovi DNA and aerobic culture was used to detect Pasteurella sp.

Population	BTV	BRSV	EHDV	PI3	M. ovi titer	M. ovi pcr	Pasteurella
Vermillion Cliffs (12B)	9(60)	0	9(60)	0	13(87)	6(40)	10(67)
Mineral Mtns (37B)	7(58)	8(67)	8(67)	4(33)	0	0	4(30)
Bighorns (42)	0	1(10)	0	0	8(80)	1(8)	3(23)
Harcuvar (44A)	0	0	0	2(17)	7(54)	2(20)	0
Galiuro Mtn	4(36)	0	5(45)	5(45)	0	0	0

Table 3: Percentage of bighorn sheep testing positive for diseases and pathogen exposure in 2021.

GMU	Number Tested	Blue T-E	EHD	BRSV	BVD	PI-3	movi ELISA	Movi PCR
16A	26	42.31	15.38	42.31	0	23.08	42.31	3.85
44A/B	24	8.33	4.17	25.00	8.33	20.83	75.00	25.00
37A	28	60.71	32.14	60.71	NT	71.43	0.00	NT
24A/B	9	88.89	44.44	33.33	NT	33.33	0.00	NT

Table 4: Percentage of bighorn sheep testing positive for diseases and pathogen exposure in 2022.

GMU	Number	Blue T-E	EHD	BRSV	BVDV	PI-3	Movi ELISA	Movi PCR
16A	26	42.31	15.38	50.00	0.00	26.92	42.31	3.85
16B	4	100.00	100.00	0.00	0.00	0.00	100.00	75.00
40A	9	33.33	100.00	11.11	0.00	0.00	44.44	33.33
43B	33	33.33	51.52	45.45	0.00	12.12	72.73	21.21
24A	9	100.00	100.00	0.00	0.00	25.00	0.00	0.00

Table 2 – Percentage of bighorn sheep testing positive for diseases and pathogens.

GMU	Actual Samples Taken	BTV	EHD	BRSV	BVDV	PI-3	M.ovi ELISA	M.ovi PCR
16A	26	42	15	50	0	27	42	4
16B	4	100	100	0	0	0	100	75
40A	9	33	100	11	0	0	44	33
43B	33	33	52	45	0	12	73	21
24A	9	100	100	0	0	25	0	0

Test and Remove

No test and remove efforts have been implemented to date. However, this management tool will be considered in response to any documented disease outbreaks in populations that may be conducive and receptive to a test and remove effort.

- Callie Cavalcant, Big Game Management Program Supervisor
- Anne Justice-Allen, Wildlife Veterinarian

British Columbia

British Columbia has 4 native subspecies of wild sheep (Thinhorns: Dall's and Stone's; Bighorns: Rocky Mountain and California).
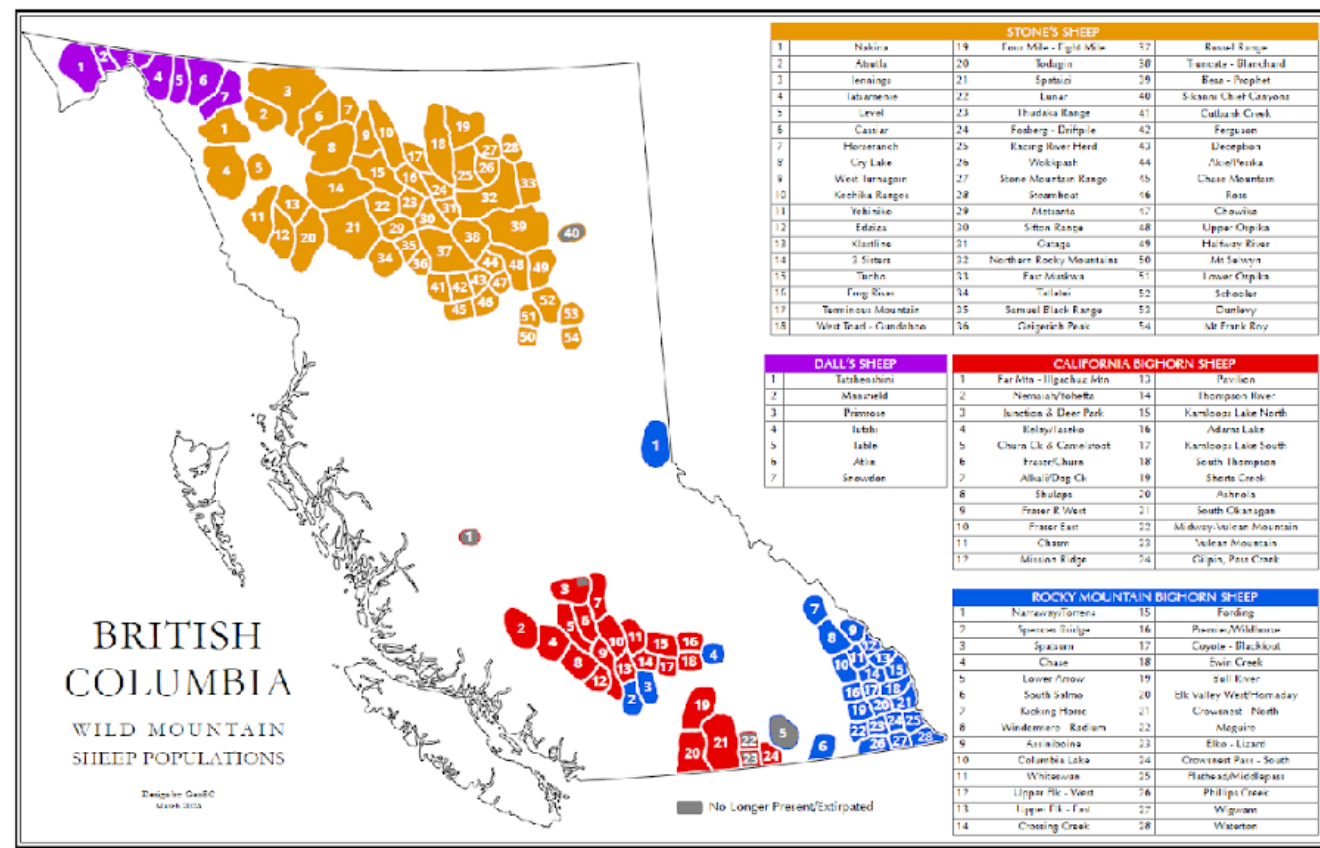
Harvest management for all species includes a combination of over-the-counter licenses for General Open Season (GOS) areas and Limited Entry Hunting Zone (LEH) draw-only hunting areas. The province currently only issues a general, non-specific sheep hunting species tag, so we are unable to report out on specific numbers of licenses sold for each of the subspecies' hunting opportunities; the information reported for licenses sold shown in Tables 1-3 in the Introduction represents the number of subspecies specific draw permits issued in the 2022/23 hunt year (Figure 1).

Figure 1. Numbers of sheep licenses sold annually in British Columbia, by hunter residency type.

Rocky Mountain & California Bighorn Sheep

British Columbia uses a combination of GOS and LEH to manage hunter harvest in both California and Rocky Mountain Bighorn Sheep populations, and has recently made changes to both GOS and LEH opportunities in an attempt to mitigate population declines and address localized harvest pressure.

B.C. is reporting significant declines in California BHS populations through the past 5 years as a result of disease and health related losses from M. ovi, Psoroptes & Blue-tongue. Affected populations include sheep in Regions 3 (Thompson), 5 (Cariboo) & 8 (Okanagan). The 2022 provincial population estimate across all regions for California BHS was ~2,000 sheep.

Rocky Mountain sheep have also declined to some degree in the Thompson region over the past decade, to ~400 RMBHS in 2022. Region 4 (Kootenays) populations have shown mixed outcomes with several populations declining below management objectives and some others showing slight improvements in populations over recent years. In March of 2021, the Kootenays released their regional Bighorn sheep management plan (https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/sheep/kootenay_bighorn_sheep_management_plan.pdf), that included a regional estimate of ~1800 RMBHS.

The continent's most northern population of RMBHS, is a cross-jurisdictional population located in

Region 7 (Peace) and Alberta. Inventory information has confirmed that this population has steadily declined since 2015. The B.C. portion of this meta-population has also declined to <75 sheep, as a result of severe weather events and predation effects; hunter harvest is currently managed through general open season and it increased to a 10% harvest rate in 2022. As such, the region is currently considering changes to hunting regulations in order to reduce the harvest rate to more sustainable levels (i.e., potentially moving to an LEH delivery). The total provincial population estimate is ~2,250 RMBHS.

Thinhorn Sheep

The Province recently drafted a Stewardship Framework for Thinhorn Sheep in B.C. This document incorporates recent genetic information, applying it across traditional Wildlife Management Unit boundaries; from this, 5 large Thinhorn sheep genetic population groups have been identified (Figure 2).

Figure 2. Current Stone's and Dall's sheep distribution.
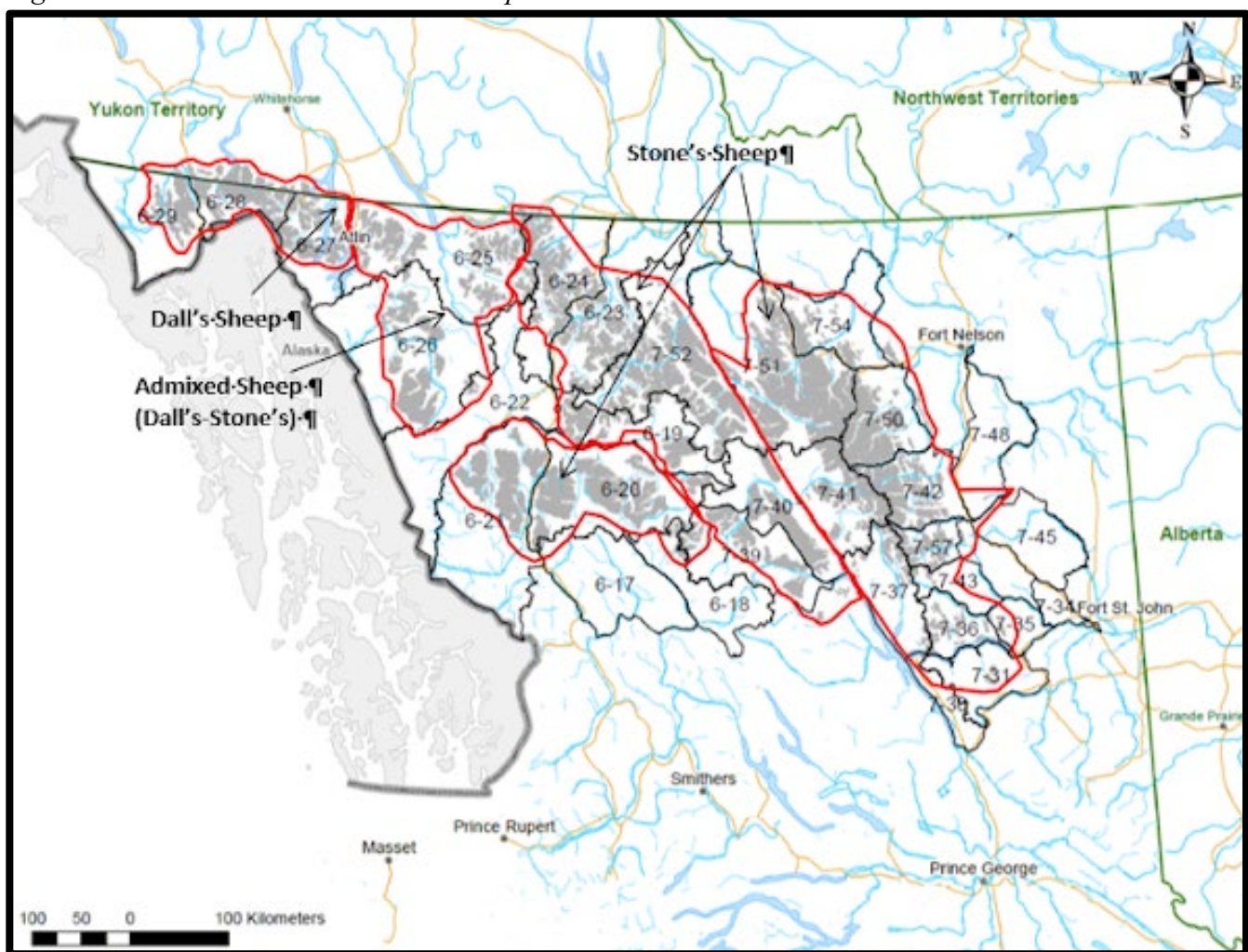
Dall's Sheep

Recent genetic information has confirmed that the range of Dall's sheep in B.C. is larger than previously thought. B.C. provided revisions to the previous estimates provided to the WAFWA WSI data records to reflect this new information (i.e., we reassigned sheep previously included as Stone's into the Dall's category). The 2022 total estimated number of Dall's sheep in B.C. is ~700, with the new geographic distribution being identified as all populations west of the centerline of the Teslin and Taku watersheds.

Approximately 75% of all Dall's sheep range in B.C. has been inventoried over the past decade.

Hunts for Dall's sheep in B.C. are predominantly managed through LEH draw hunts (for white sheep), however, some of the newly defined areas immediately west of Teslin Lake that contain Fannin or dark-phased Dall's phenotypes, continue to be managed through GOS. A review of all sheep license sales suggests that hunts for sheep in B.C. continue to increase, despite reduced numbers of LEHs being issued and this supports the general conclusion that those who receive an LEH draw are more likely to attend and hunt that opportunity today than they were in the early 2000's (Figure 3).

Figure 3. Dall's sheep license sales, 2006-2023.

Stone's Sheep

Genetic information has confirmed that the distribution of Stone's sheep in B.C. is smaller than previously thought. B.C. has provided revisions to past estimates provided to the WAFWA WSI data records to reflect this new information (i.e., we reassigned sheep previously included as Stone's into the Dall's category) and the new geographic distribution is identified as all Thinhorn sheep populations east of the centerline of the Teslin and Taku watersheds. The 2022 total estimated number of Stone's sheep in B.C. is ~12,300, however only about 35% of known Stone's sheep range has had population level inventory work completed in it over the past decade.

Hunting for Stone's sheep provides the bulk of the hunting opportunity in B.C. with most areas managed through GOS; some smaller specific hunt areas overlapping provincial park areas are managed through LEH and there is one archery-only GOS hunting area. A review of all sheep license sales suggests that hunts for sheep in B.C. continue to increase, despite reduced numbers of LEHs being issued for other subspecies of sheep, supporting the general sense that the number of hunters pursuing Stone's sheep has increased since the early 2000's. An estimate of sheep license sales focused on Stone's sheep hunting opportunity was generated by rounding-down the result of subtracting the total number of LEH permits issued from the total number of sheep licenses sold; while the specific numbers may not be accurate, the trend very likely is (Figure 4).

Figure 4. Approximate number of Stone's sheep license sales, 2006-2023.

NOTE: The estimated numbers of Stone's Sheep licenses shown in the graph are generated as a rough estimation for discussion purposes only.

Bill Jex, British Columbia Ministry of Forests, Fish and Wildlife Branch

California

Desert Bighorn Sheep

Populations

California's desert bighorn sheep metapopulation consists of 64 herd units spread across the state's southern mountain ranges. This metapopulation is managed in two distinct segments. The bighorn sheep in the peninsular ranges in the southwestern section of the metapopulation are considered a federally endangered distinct population segment and are therefore managed by a recovery plan drafted under the U.S. Fish & Wildlife Service (Figure 1). All other desert bighorn sheep populations in the State are not considered endangered but have fully protected status except for individual bighorn sheep subject to sport hunting.

In 2023 California's population was estimated at 4,500 desert bighorn sheep, a reduction from 5,000 desert bighorn sheep due to severe drought and lowered recruitment in 2021 and 2022. The drought has subsided due to heavy monsoonal moisture in the summer and fall of 2022, significant to historic rainfall in the winter of 2022-23, widespread moisture from Hurricane Hilary in August of 2023, and continued Pacific moisture in the winter of 2023-24. Lamb counts were high across surveyed ranges in 2023. The likely result is high yearling counts in 2024 and a partial and continuing recovery from the drought.

The notable exception to populations benefiting from this extreme moisture is the White Mountain population. These desert bighorn appear to have experienced a similar die-off to the Sierra Nevada bighorn in the historic winter of 2022-23, where deaths by avalanches and exposure due to widespread heavy

snowfall were common. The White Mountain population was estimated at around 200 individuals in 2024, previously estimated at around 400 individuals.

Figure 1. Bighorn sheep in California. The desert and Sierra Nevada subspecies are found in California. The desert subspecies is managed in two distinct population segments as seen below.
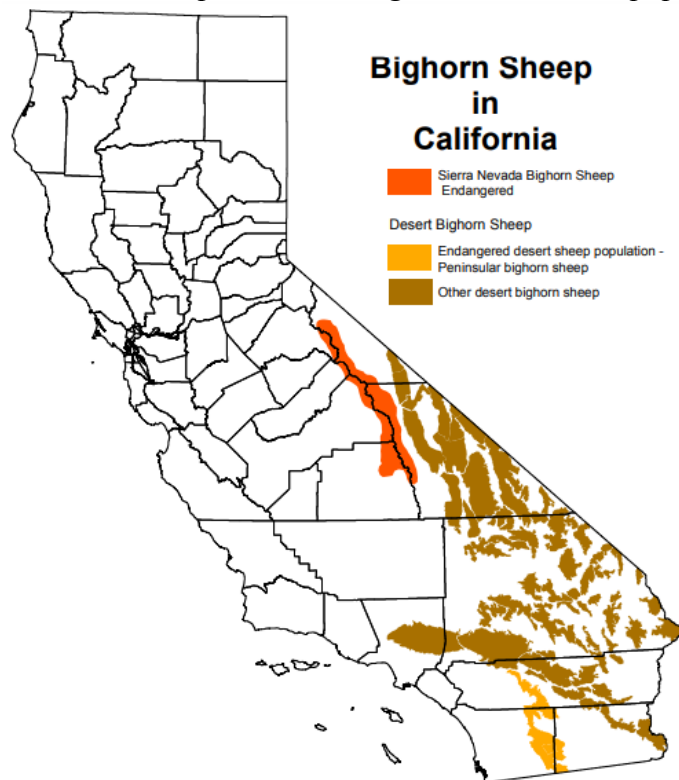
Licenses and Harvest

Per California Fish & Game Code, hunting of bighorn sheep in California is limited to rams. The California Fish & Game Commission may not adopt regulations authorizing the hunting in a single year of more than 15 percent of the mature rams (Class III or IV) in a single management unit. Hunts usually have a near 100% success rate except in the high-altitude White Mountain Hunt Zone 7. The 2024/2025 hunt season consists of 23 hunt tags (Figure 2).

Disease and Herd Health

Mycoplasma ovipneumoniae poses a significant threat to desert bighorn herds in California. Antibodies to the pathogen have been found in individuals from every herd unit tested in the State. Over the past decade, all age-class die-offs have been detected in the Old Dad, San Gorgonio, and South Bristol herds. Carcasses from the Old Dad herd sampled during the die-off tested positive for *Mycoplasma.* Carcasses from the San Gorgonio and South Bristol herds during their respective die-offs did not test positive for *Mycoplasma*; it is possible that the pneumonia in those herds was caused by a different, as-yet undetermined pathogen. All three of these populations have shown recruitment capable of sustaining or growing the current populations. No test and remove efforts have taken place in California.

Connectivity

Historically, California's desert bighorn sheep formed one large metapopulation. Three freeways (I-15, 40, and 10) have divided this metapopulation into six fragments as clearly shown by both genetic and movement data. Re-establishing genetic connectivity remains one of the top priorities for California's

desert bighorn sheep program. Construction is planned to start this year on three wildlife overcrossings traversing I-15 and a planned high speed rail line, designed specifically to benefit the species.

Figure 2. Previous success rates from the 2023-2024 season and the number of general hunt tags offered in each hunt zone for the 2024/2025 hunt season. In total there are 21 general tags, as well as 2 special fundraising tags (Open Zone and Cady Mountains) are offered for the 2024-2025 season.

Hunt Name	Hunt Code	2023 Hunter Success (%)	2023 Tag Quota	2024 Tag Quota
Zone 1 Marble/Clipper Mountains	501	100	1	1
Zone 2 Old Dad/Kelso Peak Mountains	502	100	1	2
Zone 3 Clark and Kingston Mountain Ranges	503	75	4	3
Zone 4 Orocopia Mountains	504	100	1	1
Zone 5 San Gorgonio Mountains	505	-	0	0
Zone 6 Sheep Hole Mountains	506	-	0	1
Zone 7 White Mountains	507	17	6	4
Zone 8 South Bristol Mountains	508	100	2	1
Zone 9 Cady Mountains	509	100	2	2
Zone 10 Newberry, Rodman and Ord Mountains	510	100	6	6

Danielle Glass and Rick Ianniello, Environmental Scientists, California Department of Fish & Wildlife

Colorado
Rocky Mountain Bighorn Sheep
Populations
The 2023 Colorado statewide post-hunt Rocky Mountain bighorn sheep (RMBHS) population estimate is 7,000. This is down from our contemporary peak population size of 7,500, which was reached in 2001 and 2022 (Figure 1). The statewide population has averaged 7,100 over the last 25 years. Approximately 6,300 RMBH occur in hunted populations and 700 in unhunted populations which are primarily in Rocky Mountain National Park.

From 1945 to present, Colorado conducted approximately 150 translocations of 2,500 RMBHS. Most of these occurred during the 1980's and 1990's. Approximately 55% of current herds resulting from reintroductions. These transplants continue to this day but at a much lower rate because there are very few locations remaining that have both suitable habitat for bighorn sheep and that do not have domestic sheep or goats nearby.

Licenses and Harvest
Colorado has 39 designated RMBHS populations with 70 hunted Game Management Units (GMUs) shown in red in Figure 2.

For 2024, we reduced total licenses from 351 to 341 (-10) RMBHS statewide. Ram and either-sex licenses recommendations are 250 (-3) and ewe licenses are set at 91 (-7). Ram harvest rate averages about 2.3% of hunted population size while female harvest rate is much less than 1%. See licenses and harvest from 1990 to present in Figure 3.

Figure 1. Rocky Mountain bighorn sheep population estimates.
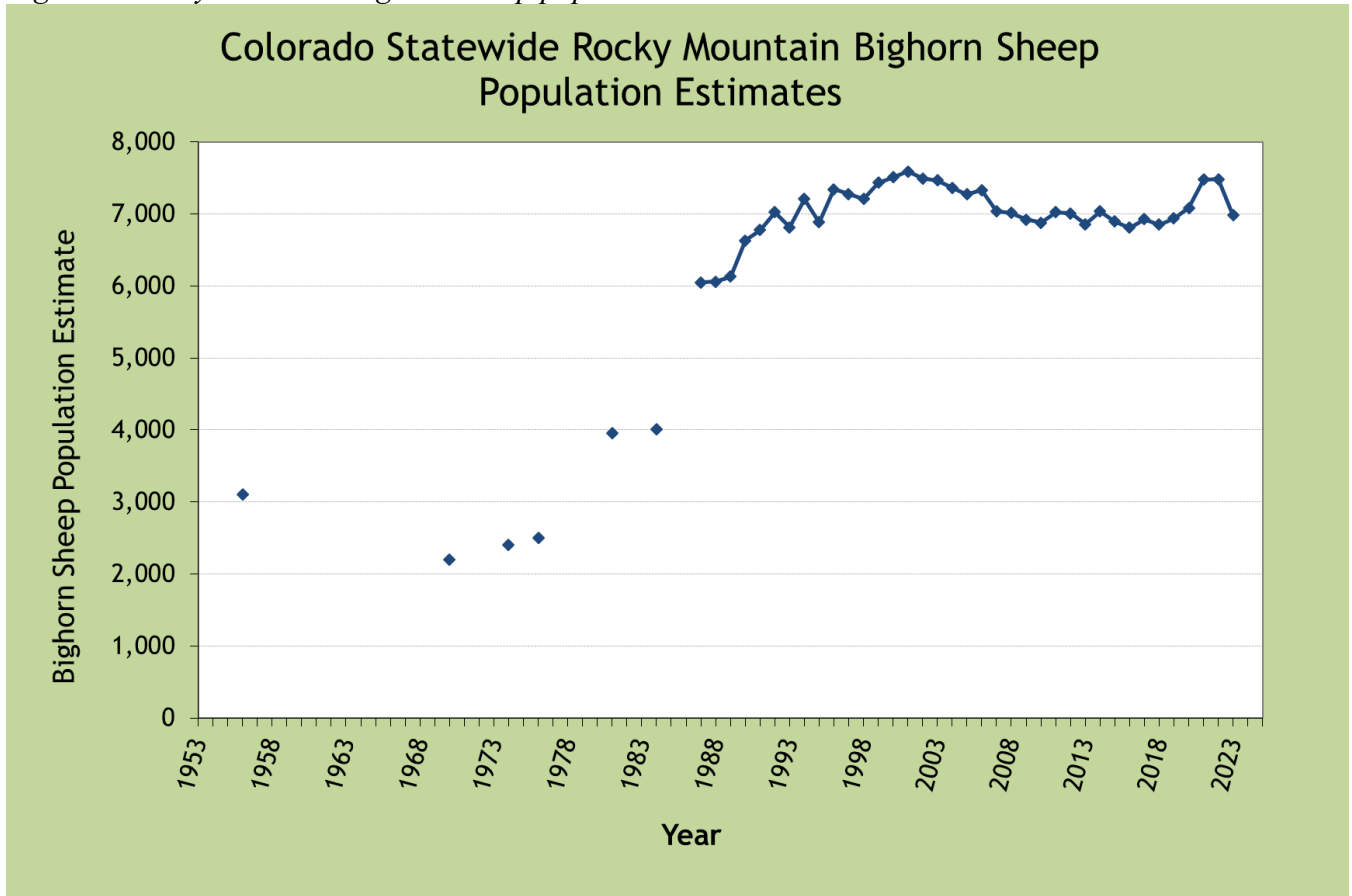
Figure 2. Colorado Rocky Mountain (red) and desert bighorn sheep (blue) game management units.
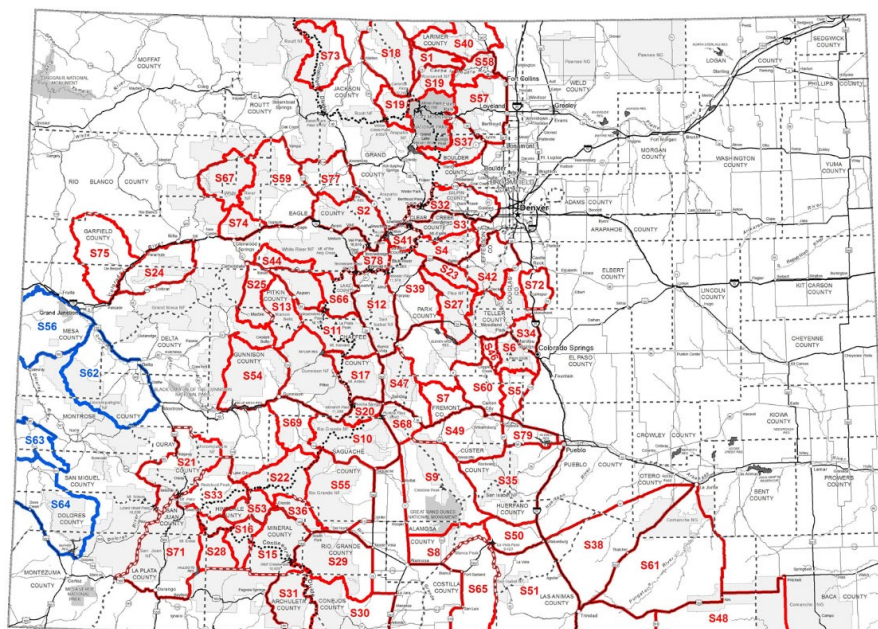
Figure 3. Bighorn sheep ram and ewe licenses and harvest.
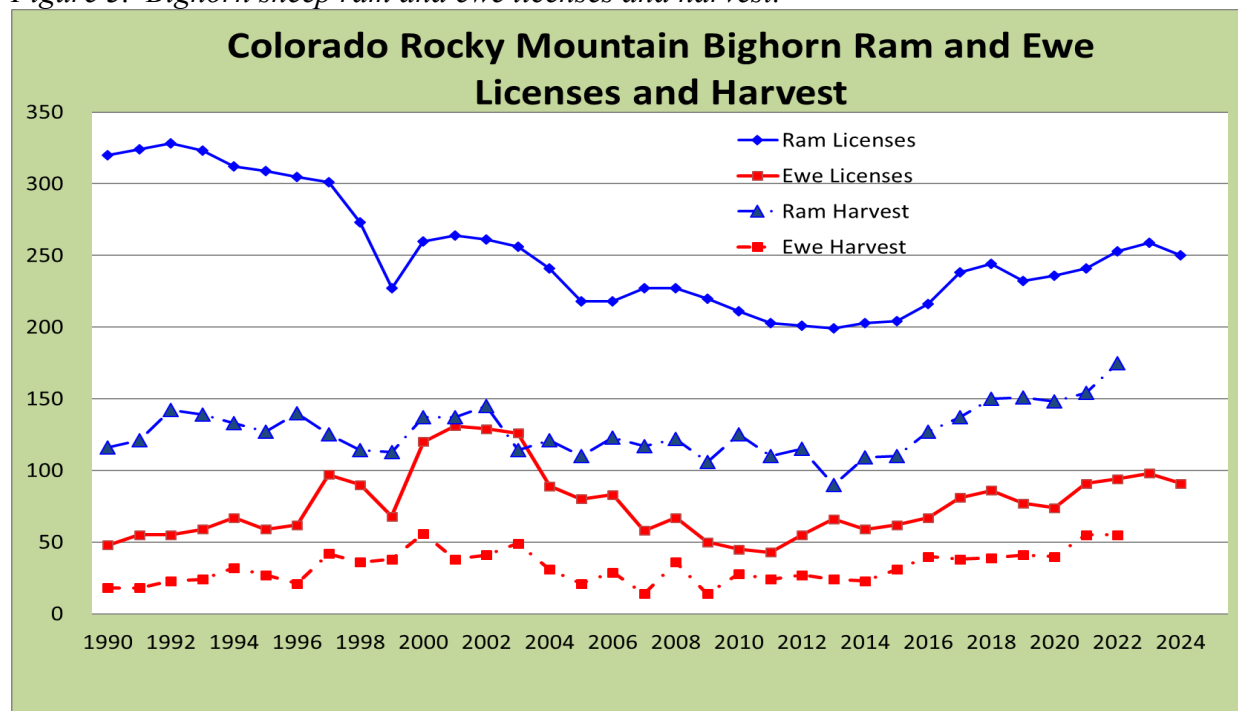
Desert Bighorn Sheep

Between 1979 and 2001, Colorado conducted 12 transplant operations and translocated 218 desert bighorn sheep from Arizona, Nevada, and Utah. As a result of these significant and expensive transplant efforts, Colorado has 2 desert bighorn sheep herds, in 4 game management units (GMUs) shown in blue in Figure 2.

The 2023 DBHS population estimate is again 500 (Figure 4). Ram licenses for 2024 will be the same as 2023 at 15. No ewe licenses have been offered yet for DBHS (Figure 5).

Disease and Herd Health

This year was not a good year for bighorn herd health. In 2023, CPW documented all-age mortality events in 3 herds and confirmed lamb mortality in 4 additional herds. We performed specific (PCR) testing for pathogens including Mycoplasma ovipneumoniae, leukotoxigenic Pasteurellaceae, and Pasteurella multocida. Necropsy of deceased bighorns demonstrated bronchopneumonia, with variable concurrence of upper respiratory disease (including sinus tumor) and detection of leukotoxigenic Pasteurellaceae, Mycoplasma ovipneumoniae, and Pasteurella multocida. Chronic upper respiratory disease (sinus tumor) was detected in several Colorado bighorn herds. Sampling approaches were tailored to the individual project and included both serology and swab-based diagnostics. Mycoplasma ovipneumoniae, leukotoxigenic Pasteurellaceae, and Pasteurella multocida were detected in various combinations among the sampled populations. No new pathogens were documented through sampling efforts but new strain types were discovered.

Test and Remove

No current test and removal programs were conducted in Colorado in 2023.

Figure 4. Desert bighorn sheep population estimates.
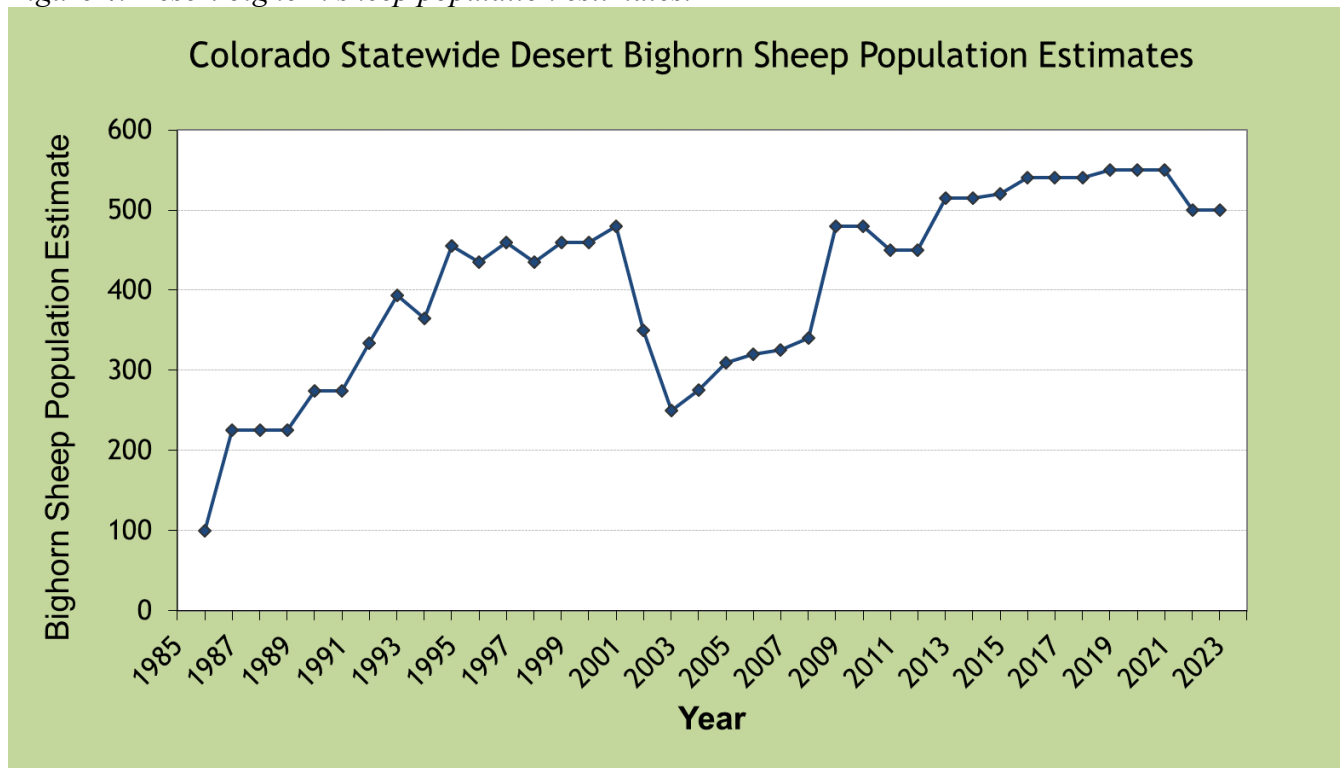
Figure 5. Desert bighorn sheep ram licenses and harvest.
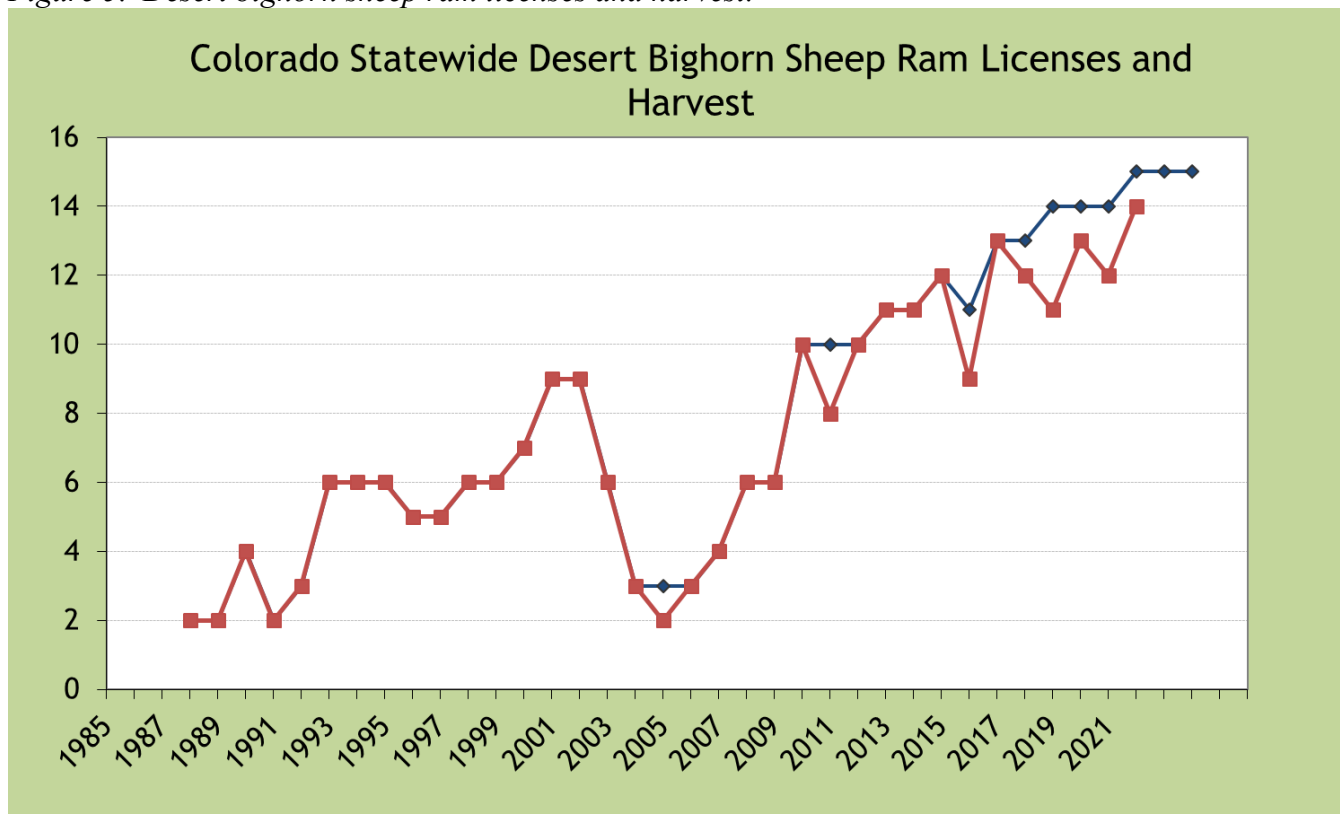
-Andy Holland, Karen Fox, and Mary Wood- Colorado Parks and Wildlife

Idaho

In Idaho, bighorn sheep exist in both small, isolated populations and in interconnected metapopulations (Figure 1). For management purposes, these populations and metapopulations have been divided into 21 Population Management Units (PMUs). Currently, an estimated 3,400 bighorn sheep occupy about 15.5% of the state. Historical and recent data indicate most PMUs can sustain higher populations of bighorn sheep and overall management direction will be to increase population levels where feasible. To attain this goal, IDFG will write an annual action plan to describe in more detail planned activities to address management directions and strategies in this plan.

Figure 1. Current distribution of bighorn sheep in Idaho, as defined by Population Management Units (PMU).
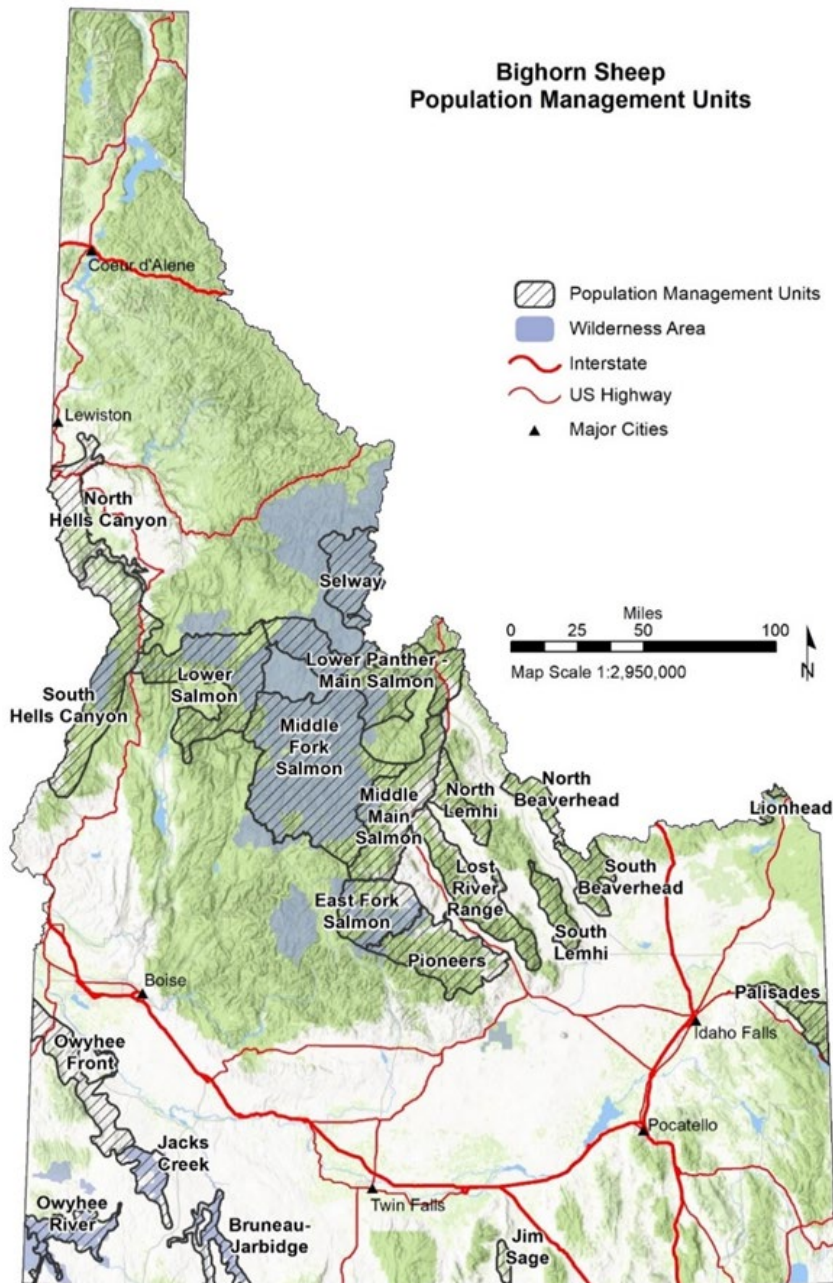
Populations

Rocky Mountain bighorn sheep (approximately 2,950 animals) occur in 16 PMUs in central and southeastern Idaho (Figure 2). Eighteen out-of-state translocations and 17 in-state translocations were conducted between 1975 and 2005 to restore Rocky Mountain bighorn sheep populations to historically occupied habitat. Translocations have successfully expanded the distribution of bighorn sheep, but most of the largest populations are still native Rocky Mountain bighorn sheep that were never extirpated in the Salmon River drainage. In south-central and southwestern Idaho about 450 California bighorn sheep occur in 5 PMUs (Figure 2). Bighorn sheep were completely extirpated from this part of the state, and current populations are the result of 11 translocations from outside Idaho and 18 in-state translocations between 1963 and 2004.

Figure 2. Statewide population estimates of California bighorn sheep and Rocky Mountain bighorn sheep in Idaho, 2000–2022. Statewide estimates are based on the most recent survey in each population management unit which may, or may not, reflect the year of the estimate.
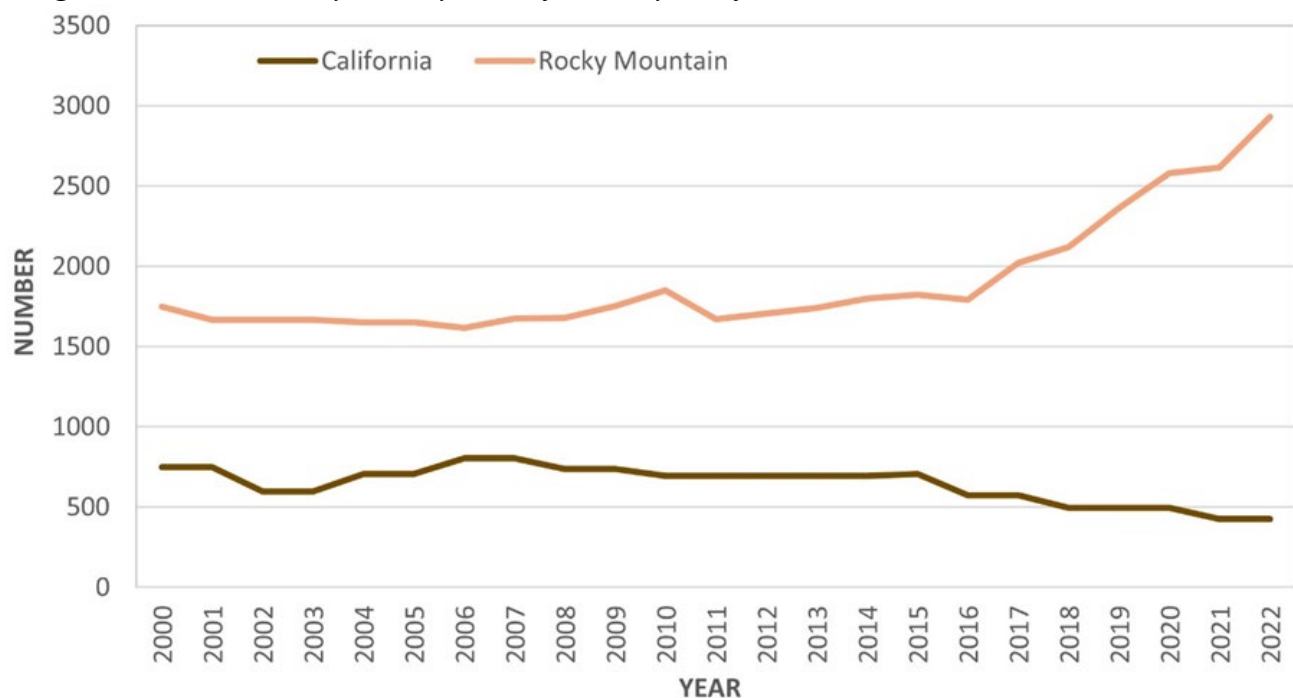
Harvest Management

Over the last 85 years, ram tags and harvest have varied considerably with changes in populations (Figure 3). Disease-related die-offs that have impacted large portions of Idaho's bighorn sheep populations typically resulted in large reductions in tag levels, followed by slow increases in tags if populations recovered.

Beginning with the 1991–95 bighorn sheep management plan, hunting was not recommended unless a population was estimated at >100 animals. However, a 100-animal minimum may preclude legitimate ram-only harvest opportunities in some smaller populations where habitat carrying capacity prevents achieving minimum population size or risk of catastrophic, all-age die-off is high.

In Idaho, harvest was restricted to ¾-curl or larger rams from 1970–1983 and ¾-curl or larger rams or rams >4 years old (≥3 annual growth rings on horns) from 1984–2006. In 2007, regulations were changed to allow harvest of any ram. Data gathered since 1994 indicate this change had no effect on the average age of harvested rams in Idaho.

Figure 3. Bighorn sheep tags (issued) and harvest 1982–2023, Idaho.
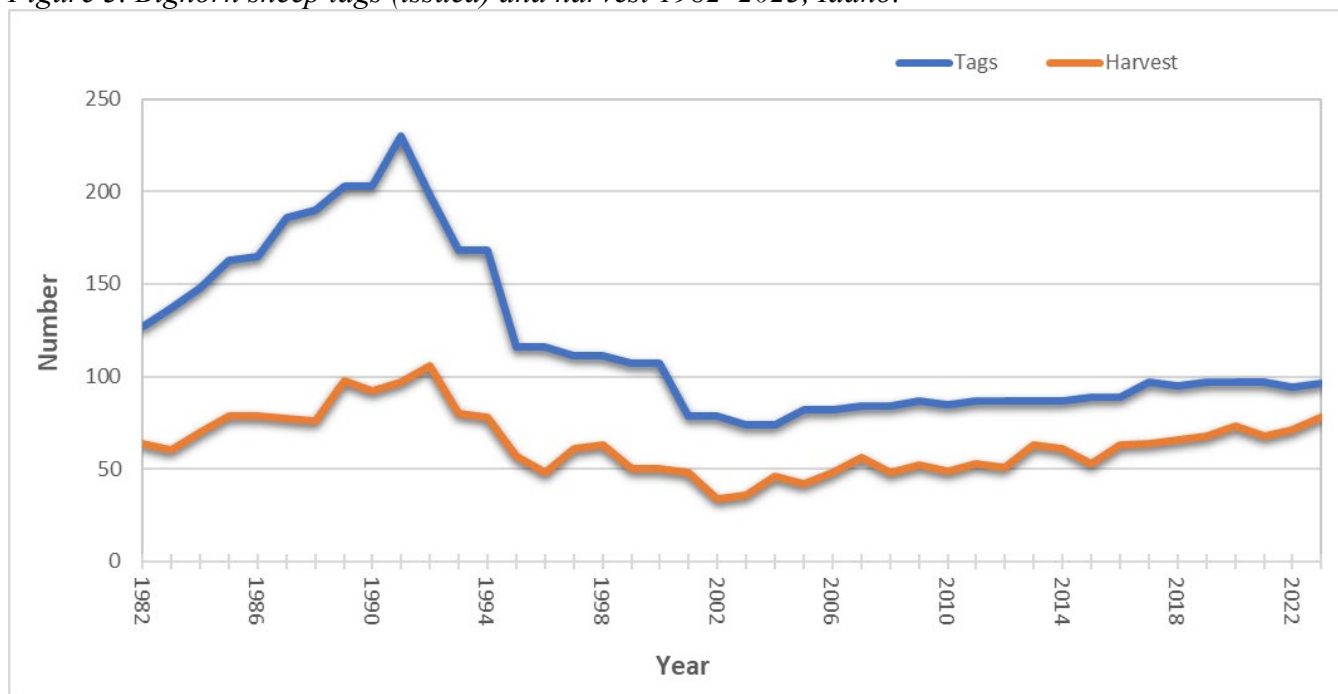
Since 1991, management direction is to set tag levels so that harvest is ≤20% of class III and IV rams (¾-curl or larger) observed during the most recent survey for each hunt area. This conservative harvest strategy ensures adequate mature rams for harvest and biological-behavioral requirements (social dominance hierarchy, genetics, mature male:female ratios, etc.).

Current timing of bighorn sheep seasons avoids hunting during the breeding season. Most bighorn sheep seasons start 30 August and continue until 8 October for California bighorns and until 13 October for Rocky Mountain bighorns. Some late-season hunts exist; for example, some hunts for Rocky Mountain bighorns extend through 31 October.

Reduction of ewe numbers may be necessary when sheep numbers have increased above population objectives, including when habitat degradation is possible due to overpopulation or bighorn sheep move into habitat with an increased risk of contact with domestic sheep and goats. Removal of ewes can be accomplished through capture and translocation (in-state or to other jurisdictions) or regulated harvest. Ewe removal is generally not recommended when populations are below habitat carrying capacity, newly reintroduced, or suppressed by a mortality factor (e.g., disease). There is currently no ewe harvest in Idaho.

All bighorn sheep hunting in Idaho is allocated via a controlled hunt (random drawing) system. Currently, nonresidents are limited to ≤10% of all bighorn sheep tags and not more than 1 nonresident tag can be issued for controlled hunts with ≤10 tags (≤10% to nonresidents in hunts with >10 tags). Chances of obtaining a bighorn tag generally declined over time as interest and demand have increased (Figure 4).

Disease and Herd Health
Population health is an essential component of bighorn sheep restoration and management. Historically disease was an important factor contributing to declines and extirpation of bighorn sheep in much of their range and disease continues to limit bighorn sheep numbers today. Not only does disease affect populations directly, risk of disease transmission also affects where and how IDFG manages for bighorn sheep in Idaho.

Figure 4. Resident, nonresident, and total number of applicants for bighorn sheep tags 1982–2023, Idaho.
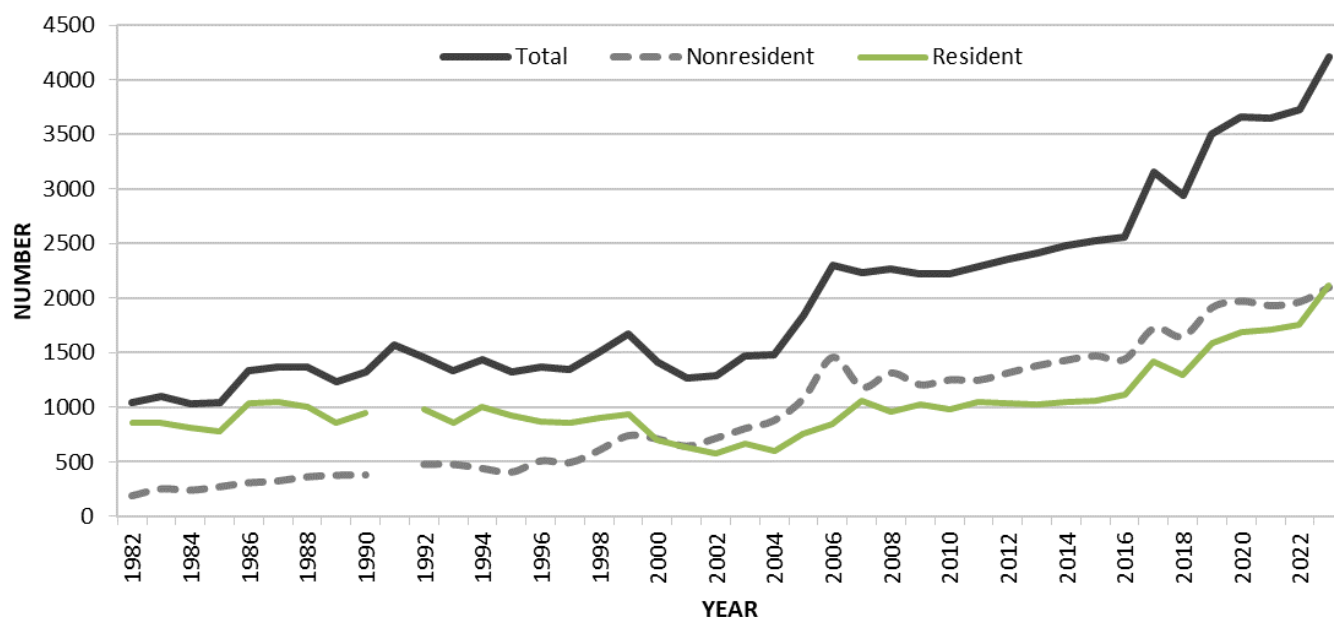
The primary limiting factor for Idaho bighorn sheep populations is disease, although other factors including habitat, genetics, climate change, predation, and hunting can also be important. The disease that has the most widespread and severe impacts on bighorn sheep population abundance is a microbiologically complex pneumonia triggered by the bacterium *Mycoplasma ovipneumoniae*, commonly referred to as "Movi".

In December 2023, *Mycoplasma ovipneumoniae* (Movi) and pneumonia were detected in Hells Canyon bighorn sheep for the first time in over 5 years. Pneumonia appeared to peak in January 2024 and number of mortalities observed has declined since then, although Movi is still present. Detections of Movi and pneumonia have been limited to populations along the Snake River in Idaho, Oregon, and Washington. As of April 2024, we have received strain-typing results from WADDL on 12 Movi detections and all were identified as strain BHS-056. This strain has never been detected in Hells Canyon before. It was first identified in a 2020 pneumonia outbreak in the Lookout Mountain and Burnt River bighorn sheep populations in Baker County, Oregon, and was detected in Salmon River bighorn sheep above Riggins from 2021-2024. We are continuing to monitor and prepare for additional captures and testing to guide management.

IDFG is currently conducting test and remove research/adaptive management to clear Movi from multiple infected bighorn sheep populations. This includes testing and removing infected sheep in the Lower Salmon, Lower Panther-Main Salmon, and the South Beaverhead PMUs. We are also gathering baseline data in other populations.

Hollie Miyasaki, Idaho Department of Fish and Game

Montana

Rocky Mountain Bighorn Sheep

Populations

Rocky Mountain bighorn sheep (RMBHS) in Montana suffered widespread population reductions during the late 19th and early 20th centuries. Subsequently, various conservation measures were initiated and RMBHS populations stabilized with estimates by 1950 at approximately 1,200 sheep throughout the state. Beginning around the middle part of the 20th century and continuing over the next several decades, significant translocation and management efforts were completed to help improve population levels and increase distribution (Figure 1). To date, approximately 3,000 RMBHS have been translocated in MT (including out of state transplants) to augment and/or re-establish populations, which continue to occur, albeit on a limited basis for a variety of reasons. Montana currently completes statewide population estimates every two years and as of 2022, RMBHS population estimates comprises approximately 4,800 sheep (Figure 2). The long-term average (1984 to present) estimated state population is approximately 5,400 sheep.

Figure 1. Distribution of RMBHS within MT state jurisdiction and associated hunting districts.
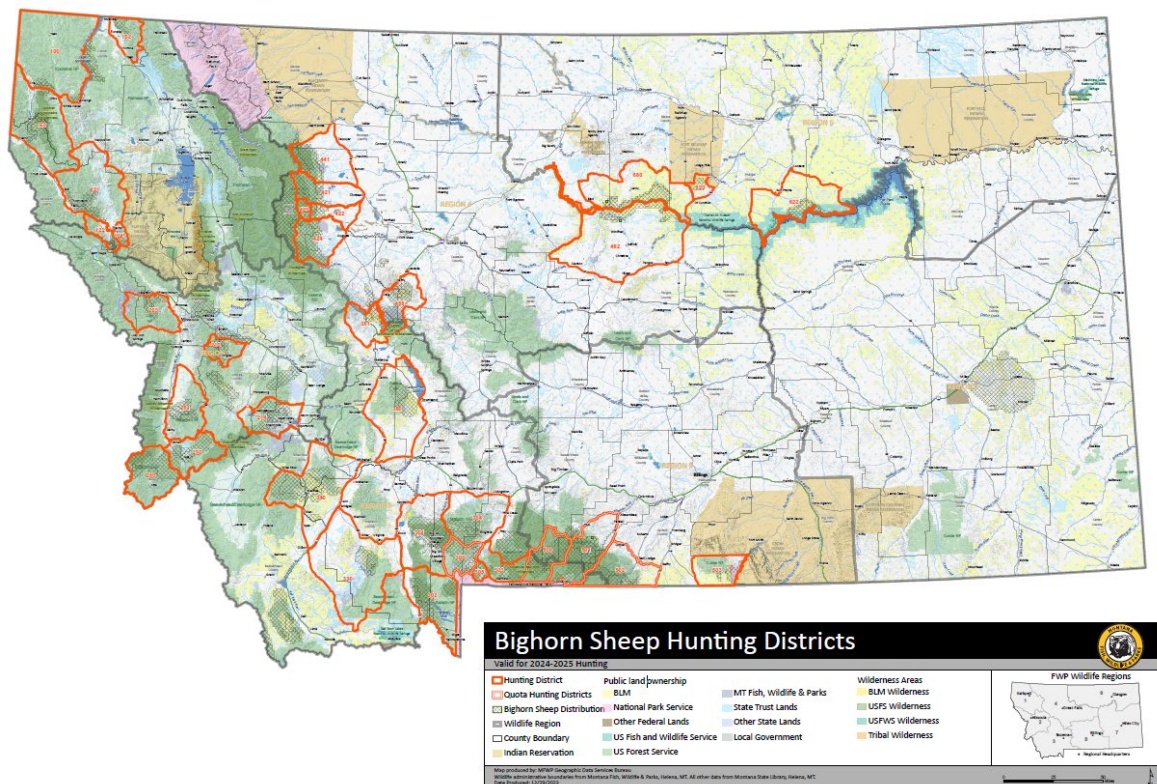
Licenses and Harvest

Montana has 36 RMBHS hunting districts (HDs) providing opportunity for limited either-sex/legal ram/any ram, unlimited legal ram (quota areas), and adult ewe license permit types. Montana's primary bighorn sheep hunting seasons include a limited archery-only season in early September (excludes three unlimited areas) and a general season (archery or rifle) that is open September 15 through the last weekend in November. For 2023, 120 limited either-sex or legal ram licenses were allocated. Recent average statewide limited either-sex/legal ram license drawing success rates is 0.52% and 0.12% for residents and nonresidents, respectively (Figure 3).

On a statewide level, there continues to be increased interest for this hunting opportunity yet

cumulatively maintained or decreased license allocation for a variety of reasons, ultimately leading to decreased odds of drawing over time (Figure 3). This is especially true for resident applicants (nonresidents are capped at a constant allocation rate of not more than 15% of licenses available). For example, in 2014, over 19,000 residents vied for 116 available limited licenses compared with over 27,000 applications for 120 licenses in 2023 (Figure 3). A reduction from 0.60% to 0.41% drawing success rate. Similarly, applications for adult ewe hunting opportunities continue to increase while in general (statewide), license allocation has become more limited. In 2014, 540 residents vied for 126 available limited adult ewe licenses compared with 677 applications for 70 licenses in 2023. A reduction from 23% to 10% drawing success rate.

Figure 2. Population estimates are derived via professional biologist data and judgment and not a rigorous statistical enumeration process. Prior to 2010, statewide population estimates include all known wild sheep within the boundaries of the state (including Glacier National Park). Beginning in 2010/2011, estimates include sheep within only MT state jurisdiction. Beginning in 2018, population estimates are completed every other year.
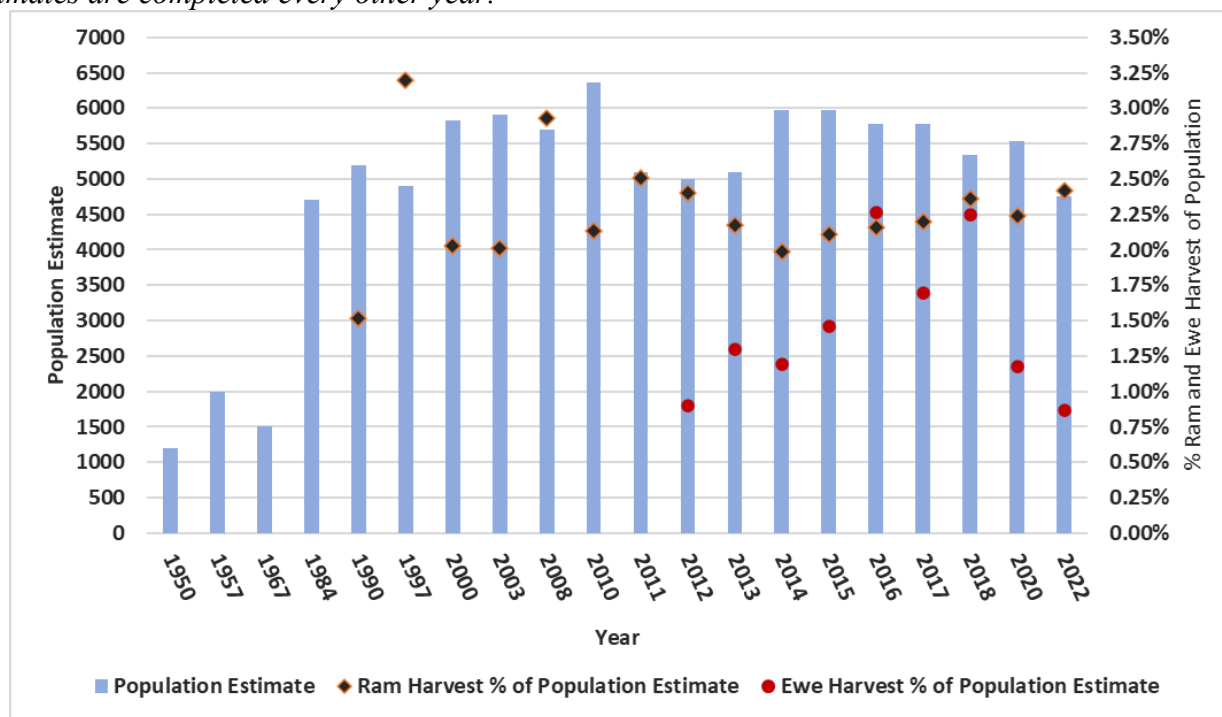
Average annual statewide either-sex limited license harvest success rates is over 95% (Figure 4). Five HDs in Montana provide unlimited legal ram hunting opportunities managed through individual quotas. 2023 harvest data portray a 3% harvest success (all five HDs combined) for these license holders (n=397). Annual statewide average age of harvested rams is consistently a little over 7 years old. Limited adult ewe hunting opportunity is currently available in four HDs with a total of 77 licenses that were available for the 2023 season. Recent annual average statewide harvest success rates for adult ewe licenses are just under 46% (Figure 4). Adult ewe hunting opportunity is an ongoing balance correlated with other population/distribution control measures where necessary (i.e., translocation work).

Disease and Herd Health
There has been only one significant recent respiratory disease outbreak involving RMBHS within Montana's state jurisdiction. During the winters of 2020 and 2021 a total of 84 bighorn sheep were translocated within Montana from near the Missouri River to the Little Belt Mountains. Sheep began

presenting pneumonia symptoms in April 2021 and a total of 14 were confirmed to have been killed by the disease. Other translocated sheep exhibited symptoms but later recovered. The exact degree to which subsequent lamb survival was impacted is unknown but biologists have observed successful lamb recruitment during 2022 and 2023. All translocated sheep were fitted with GPS collars and no commingling of BHS and domestic sheep was detected prior to the disease outbreak. Predation, primarily by mountain lions, remains the predominant cause of mortality in this reintroduced herd.

Figure 3. Cumulative number of applicants for limited either-sex/legal ram/any ram license types and associated annual percent successfully drawn.
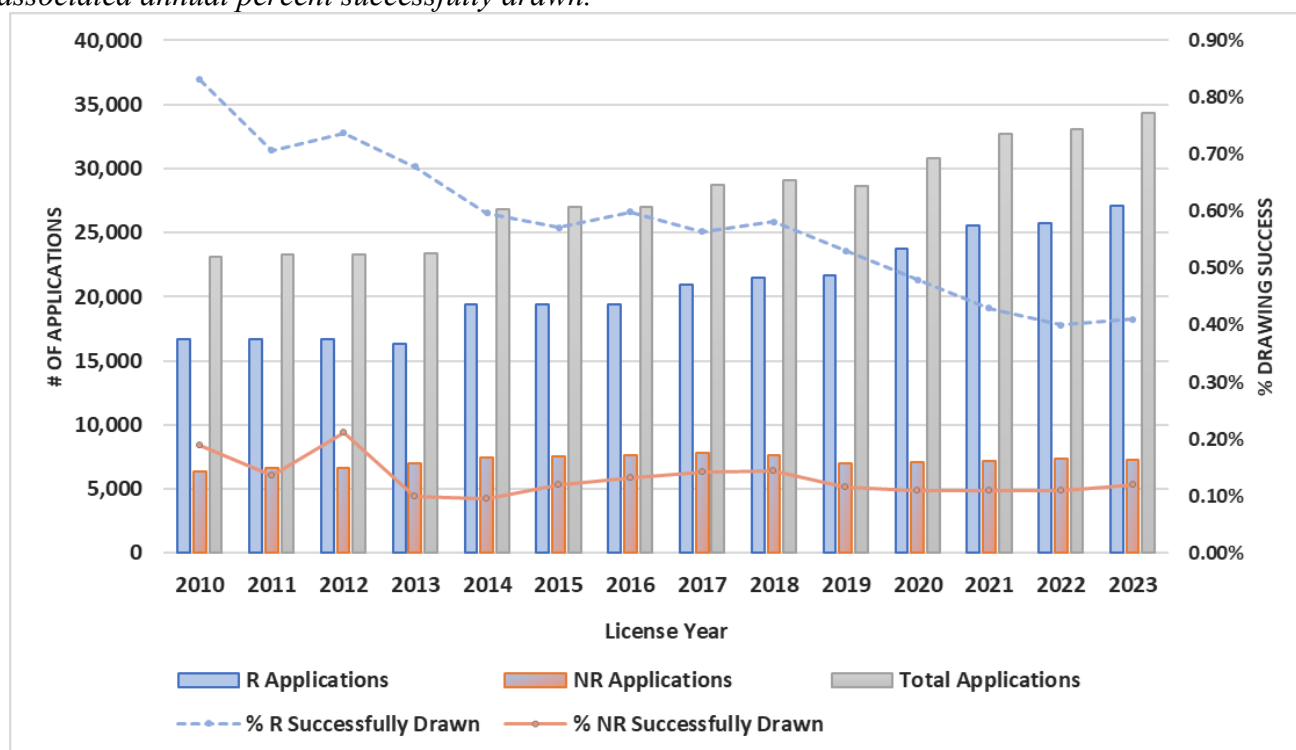
There are several herds that continue to recover from more recent disease and die-off episodes over the last decade or more, with some herds (not all) showing improved progress towards population stability and/or recovery. As such, several RMBHS herds in Montana are below population objective. For many of these areas, monitoring and/or recently completed or ongoing research is occurring to better understand and inform future management direction.

Finally, Montana Fish, Wildlife & Parks formally began new statewide research projects aimed at 1) better understanding how various management regimes influences RMBHS population dynamics within select herds across the state and 2), improve our understanding of the factors that influence the probability of wild and domestic sheep/goat contact, and to use that information to further explore tools to maintain effective separation and prevent disease-related issues for both wild and domestic animals. These projects are large collaborative efforts with the University of Montana, Montana State University, Montana Woolgrowers Association, Montana Wild Sheep Foundation, private domestic sheep producers, private landowners and others. Both projects are scheduled to take place over a 5-year period.
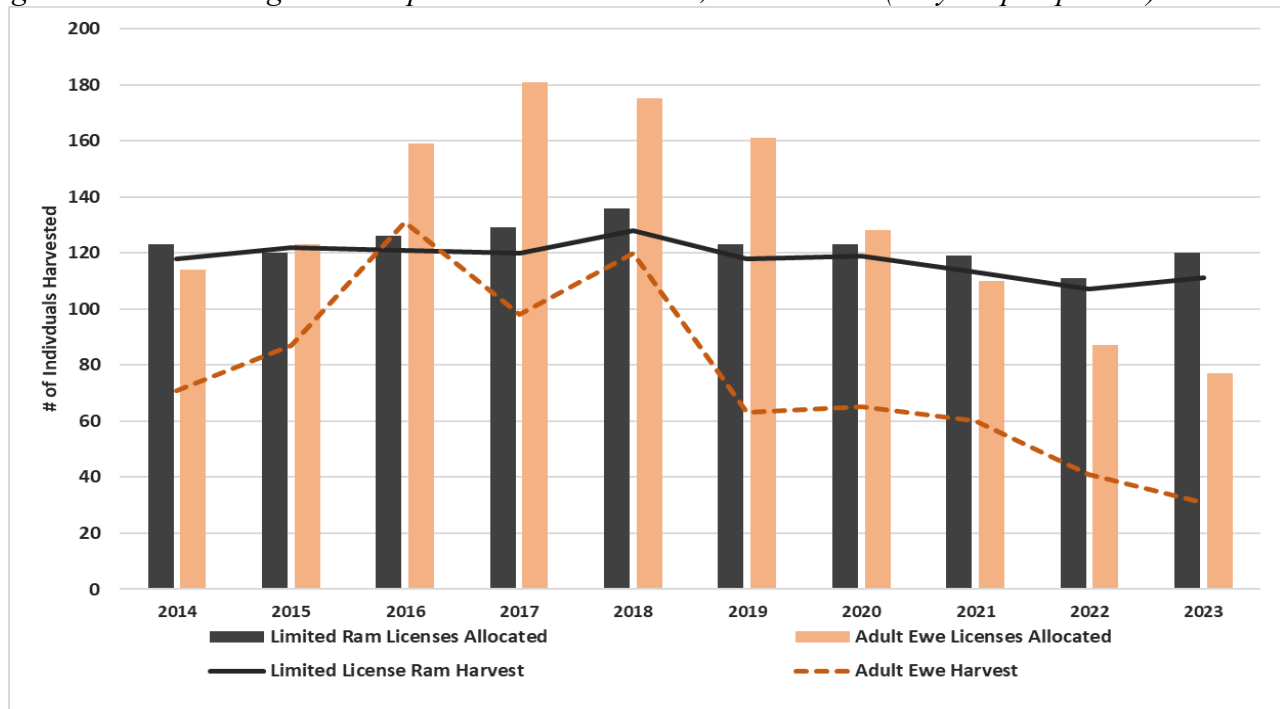
Test and Remove
Currently, the Highland Mountains RMBHS population is undergoing a 5-year research effort to better understand ongoing impacts of disease and general herd health since their initial die-off nearly 30 years

ago. A before-after analysis of ewe and lamb survival and/or *Mycoplasma ovipnuemonia* (M. ovi) prevalence is being employed where the "before" years (Years 1-3) consist of pre-treatment testing of individuals to identify chronic shedders (two or more consecutive positive test results for M. ovi), estimate vital rates and cause-specific mortality. Removal of chronic shedders will occur in Years 4 -5 and correlations to lamb survival and overall population performance will be evaluated. The project is currently in Year 3. Lab results from this winter's sampling are pending. To date, two chronic shedders have been identified, and one of those already died naturally.

Figure 4. Montana bighorn sheep ram and ewe harvest, 2014 – 2023 (10-year perspective).

While not formally a test and remove project, monitoring of the Tendoy Mountains RMBHS de-/repopulation project has been ongoing since the 2021 initial translocation of RMBHS into the Tendoys. In the years since the release, the herd has seen robust annual population growth. The small number of collars still operational from the initial release was supplemented by research captures in 2024 in which 7 RMBHS sheep were GPS collared and a total of 9 were disease tested. All sheep tested negative for M. ovi. Pending performance of these sheep and availability of supplementary source sheep, there are potential plans for additional augmentations into this area in the future.

In the upper Yellowstone area, at least a dozen RMBHS died in December/January (2023/24). Mortality affected rams, ewes, and lambs. Most were in the Cinnabar winter range area. Of those that were necropsied, most looked like classic pneumonia symptoms. Samples tested came back negative for M. ovi and thus far no definitive results portraying cause of mortality has been made. Our Montana FWP wildlife health lab is working with Wyoming Game and Fish to share samples and compare results from the Devil's Canyon RMBHS die-off (*Mannheimia haemolytica* outbreak) that occurred in the fall/winter of 2022/23. Fortunately, late winter/early spring (2024) observations in the upper Yellowstone area portray no further mortalities.

Brent Lonner, Montana Department of Fish, Wildlife and Parks

Nebraska

Rocky Mountain Bighorn Sheep

Populations

The Rocky Mountain Bighorn Sheep (RMBS) population consists of 5 herds totaling approximately 215 (2023) sheep scattered throughout western NE. After a nearly 100-year absence to the state, 1981 marked the first of 5 reintroductions to establish bighorn sheep back into their historic habitats. Over the past 10 years, RMBS numbers have declined by about 30% (Figure 1).

Figure 1. Bighorn sheep population estimates.
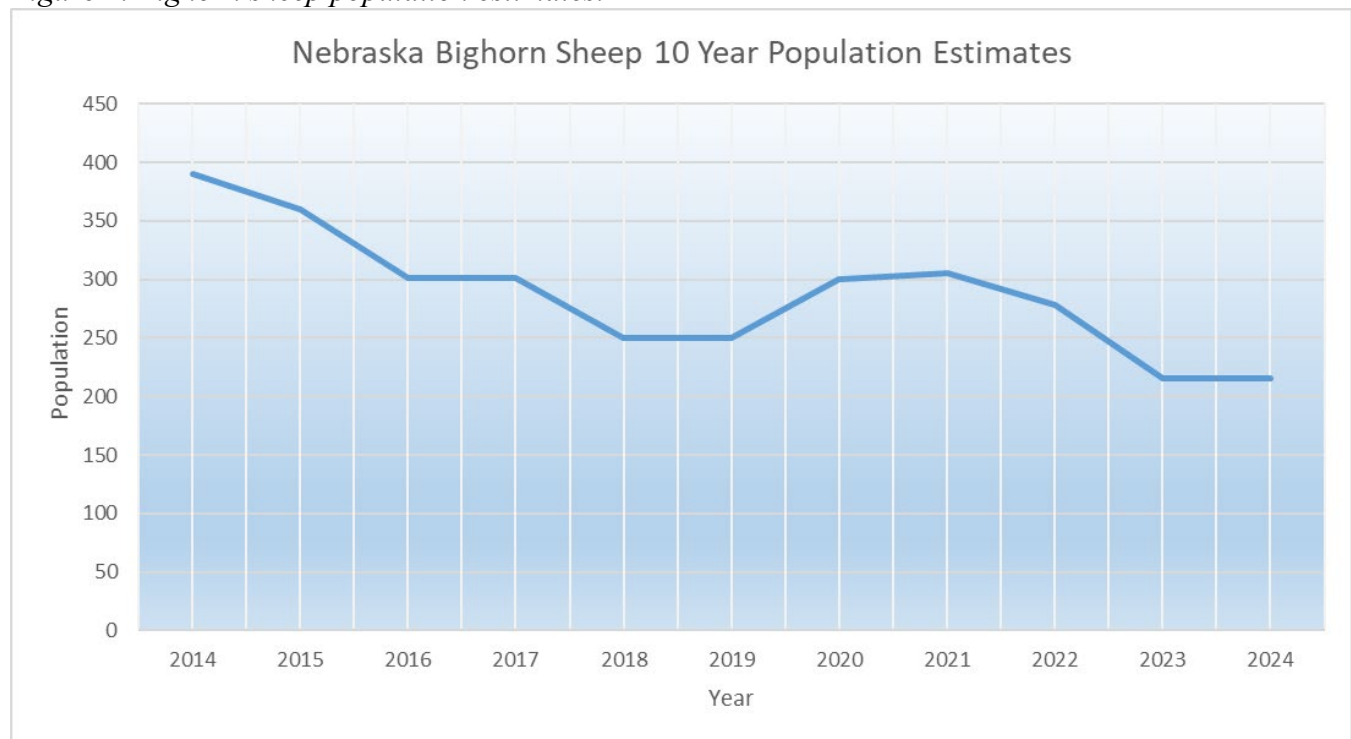
From 1981 to present, Nebraska has conducted 5 translocations of approximately 175 RMBS. One internal translocation was conducted in 2014. Other translocations are being considered in unoccupied habitats as RMBS become available for transplant.

Licenses and Harvest

Since 1998, 34 rams have been harvested in Nebraska with a success rate of 100%. Permits typically consist of 1 auction permit and 1 Nebraska resident lottery permit. Any sheep (ram or ewe) is allowed for harvest but only rams have been taken thus far.

Test & Remove

Over the past few years, the Test and Remove method has been implemented in 3 of the 5 herds showing some initial positive results with greater lamb recruitment in some regions. More recently, a bighorn sheep capture took place in February of this year experimenting and evaluating 3 different *Mycoplasma Ovipneumoniae* (Movi) detection methods. These included the standard lab tests through the Washington Animal Disease Diagnostic Laboratory (WADDL) as well as the Biomeme field testing unit (Table 1) and Working Dogs for Conservation. While there was not a 100% percent match between methods, having in-field results with possible Movi detections did allow for more immediate management decisions to be made. Initial plans to transplant some of these captured sheep from this

previously clean herd were put on hold until further evaluations can be made. Below are comparisons amongst WADDL and the Biomeme unit from the Hubbard's Gap and Cedar Canyon herds in Nebraska's southern panhandle. Kate Huyvaert, Washington State University, conducted the Biomeme testing and results analysis. Evaluation from the Working Dogs for Conservation is ongoing. In 2024, comparisons continued to be made but additional Biomeme restrictions limited its use (Table 2).

Disease testing will continue with each herd through future helicopter captures, darting and any mortalities, along with future plans to fill unoccupied habitats with RMBS sheep from clean herds.

Table 1. Movi infection and serologic status (proportion of total tested) by testing method. Animals were captured by helicopter and sampled during February 2023, Wildcat Hills, NE, USA.

	Hubbard's Gap (n=25)			Cedar Canyon (n=11)		
Test	Positive	Indeterminate	Negative	Positive	Indeterminate	Negative
WADDL PCR	0	0.04	0.96	0.18	0	0.81
Biomeme PCR	0.12	0.04	0.84	0.18	0.18	0.54
WADDL cELISA	0.36	0.12	0.36	0.36	0.18	0.45

Table 2. Movi infection and serologic status (proportion of total tested) by testing method. Animals were captured by helicopter and sampled during February 2024, Wildcat Hills, Pine Ridge NE, USA.

	Hubbard's Gap (n=27)			Pine Ridge (n=05)		
Test	Positive	Indeterminate	Negative	Positive	Indeterminate	Negative
WADDL PCR	0.11	0.11	0.98	0	0	1.00
Biomeme PCR	-	-	-	-	-	-
WADDL cELISA	0.65	0.08	0.27	0.2	0	0.8

-Todd Nordeen, Nebraska Game & Parks Commission

Nevada

It is estimated based on historic explorer and naturalist records, well-documented anecdotes in early newspapers, broad paleontological data, and a geospatial analyses of bighorn terrain, that Nevada's bighorn sheep numbers prior to European settlement were 30,000 – 50,000. Historically, the entire state including both the Mojave and Great Basin Deserts and Mountains were occupied by a single species of desert bighorn sheep (Ramey 1993, 2000; Wehausen 2000), but with different races adapted to a tremendous amount of climatic and elevation gradient.

Nevada's bighorn sheep population was at its lowest in the late 1950s at approximately 2,500 animals. They primarily occupied the lower one-third of the state (see remnant polygons on map) with the entire northern half of the state completely extirpated of bighorn primarily from pneumonia dieoffs contracted by comingling with domestic sheep that numbered as high as 3 million in Nevada in the early 1900s. The first experimental bighorn transplants occurred in 1968 but it wasn't until the late 1970s that bighorn translocations were successful. To date, 2,111 desert bighorn were reintroduced, and 1,005 California and 326 Rocky Mountain bighorn were introduced into Nevada. Most of the transplants were highly successful with the peak statewide bighorn population estimate in 2019 at 12,500. As was planned, a great deal of herd connectivity was created from all these reintroductions with narrow valleys separating many of the mountain ranges that allow for bighorn forays. Most of this connectivity was created in desert environments with no domestic sheep operations. In other areas of higher elevations and more productive habitats, a few reintroduced bighorn herds were established 10-50 miles from public land domestic sheep allotments and trailing routes. Regardless of distance, pathogen transmission was accelerated over the last

15-20 years for both domestic-bighorn and bighorn-bighorn interaction. This resulted in several metapopulation disease events with some dieoffs having no known domestic sheep source, especially in the Mojave Desert. Five years after peak levels, the 2024 statewide estimate sadly dropped to 8,400 bighorn adults (Figure 2).

Figure 1. Occupied bighorn sheep habitat distribution of bighorn sheep in Nevada categorized by remnant, introduced, and pioneered in Nevada.
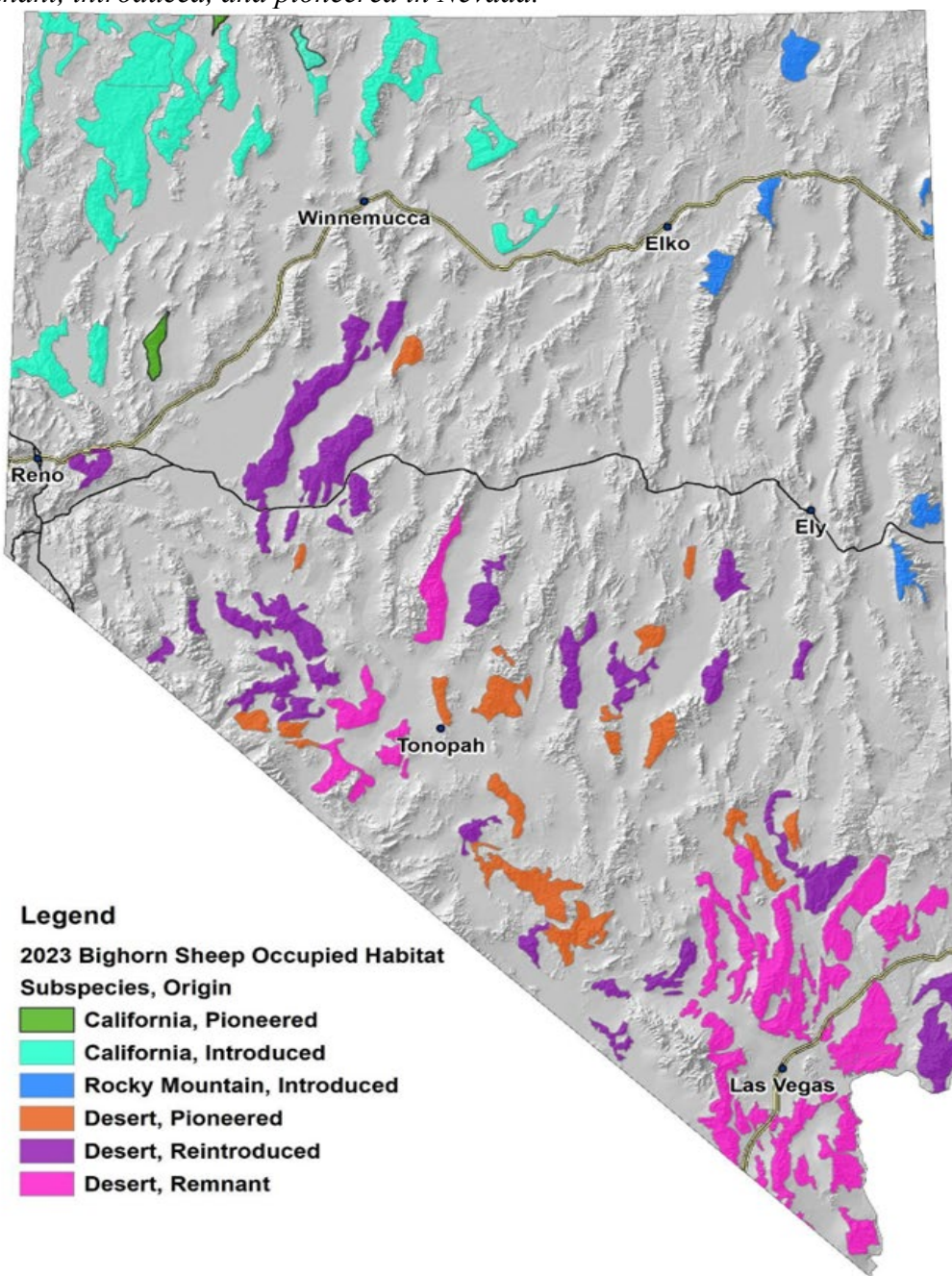
Figure 2. Statewide bighorn sheep population estimates by subspecies 1965 – 2024. Population estimates for 2024 labeled on graph for each subspecies population.
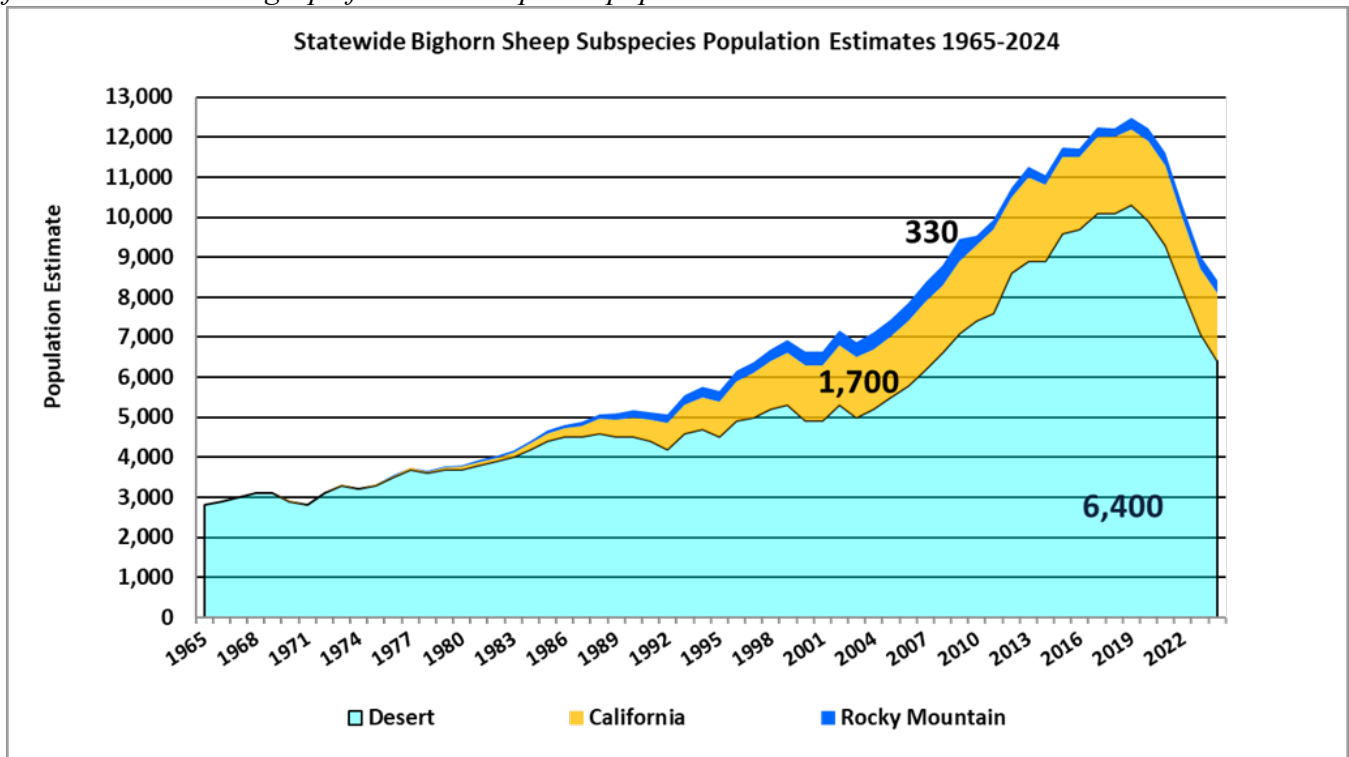
Population Performance
Desert Bighorn Sheep

Desert bighorn lamb recruitment that supports herd recovery and growth continued to slowly improve to 27 lambs:100 ewes compared to 23 and 21 lambs:100 ewes in 2022 and 2021, respectively, but still well below the long-term lamb ratio since 1990 of 38 lambs:100 ewes. We continued to see a statewide decline in desert bighorn sheep with an 11% drop from 7,200 in 2023 to the 2024 estimate of 6,400. This is a 38% decline since its peak in 2019 at 10,300. The last time the statewide estimate was this low was in 2007. This decline was attributable to many factors including: 1) the multi-year drought that ended in 2022, 2) competition at and destruction of critical riparian/water sources from excessive feral horses and burros, 3) continued high lamb mortality from pneumonia in most desert bighorn herds and 4) lion predation on small, depressed herds has contributed to a "predator pit" state where lamb recruitment is unable to overcome losses from predation.

California Bighorn Sheep

The 2023 aerial surveys classified over 1,000 California bighorn sheep with another increase in the lamb ratio of 46 lambs:100 ewes compared to 43 in 2022 and 29 in 2021 during the worst of the drought period. The multi-year drought, overgrazing and degraded riparian areas from excessive use by free-roaming horses and burros and cattle, and mountain lion predation continues to suppress population growth. The 2024 statewide California bighorn population estimate is stable at 1,700 adults.

Rocky Mountain Bighorn Sheep

Aerial and ground surveys conducted in 2023 in 4 of the herds classified 158 bighorn sheep with very encouraging metrics of 60 lambs:100 ewes and 66 rams:100 ewes. The statewide population estimate of the 6 Rocky Mountain bighorn herds is static at 330 adults.

Hunt/Harvest Metrics for All Subspecies

Desert Bighorn Sheep

In the 2023-2024 hunt season, there were 235 desert bighorn ram tags compared to 294 the previous year. The 235 tags included 211 for standard seasons, 8 archery only, 5 specialty tags, 4 management (access-limited) tags, and 12 one-horn ram tags. Excluding the 1-horn ram hunt, there were 188 rams harvested in 2023 for 85% success of tags used. There was a slight uptick in ram horn metrics statewide in 2023 with 11 rams (only 7 in 2022) that scored above 170 B&C pts. The previous drought years continued to impact both horn base and horn length in 2023 and likely for the next few years. Statewide average days hunted was 6.7, the highest recorded, which is a combination of both difficulty of finding mature rams, but also more hunters are spending quality time enjoying the month-long hunt. The most positive hunt metric was average age of harvested rams, which was again the highest recorded at 6.9. The one-horn ram hunt continued to be a great once-in-a-lifetime hunt for those that put the time in with 5 successful hunters at 50% success rate with average age of harvested rams at 9.2. The 2023 demand for desert bighorn ram hunting leveled off for resident applicants at 12,106 but continued to grow by nonresidents that surpassed 14,000 unique applicants for the first time. The 2023 desert bighorn ewe hunts harvested 20 ewes and 24 ewes from Units 161 and 268, respectively. Overall success rate was 56% of hunters afield. The number of desert bighorn ewe applicants showed a slight increase from 2,183 applicants in 2022 to 2,352 in 2023.

California Bighorn Sheep

The 2023 California bighorn ram season was another challenging year for many hunters. Hunter success was the lowest on record at 80%, compared to long-term average of 92%. Average hunt days continued to trend up to over 10 days, with the last 3 years being over 8.5 days. Average age of harvested rams dropped again to 6.0 compared to long-term average of 6.9 years over the last 20 years. The average B&C score showed a slight improvement up to 149 5/8 from an all-time low last year of 146 1/8. The previous multi-year drought will continue to influence both horn base and length. Demand for California bighorn ram hunts continued to rise in 2023 with 22,080 total unique applicants compared to 21,452 applicants in 2022.

Rocky Mountain Bighorn Sheep

Only 2 Rocky Mountain bighorn ram tags were available in 2023, the lowest tag quota since 1995 (first season was in 1985). This was the second ram season in the Ruby Mountains, Unit 102 since the all-age dieoff in 2010. As with the 2022 season, both hunters in Unit 102 had great hunts, harvesting 177 B&C-class rams averaging only 3.5 days. The other tagholder in the South Snake Range below the Great Basin National Park, struggled during the season and finally harvested his mature ram in February. Figure 3 depicts annual ram harvest for all subspecies since 1965. Peak ram harvest was 356 in 2017 with 300 rams being deserts.

Disease and Herd Health

Pneumonia dieoffs have significantly impacted Nevada bighorn herds in the last 20 years. Approximately 60 of the state's 81 bighorn herds have experienced upper respiratory disease events. The impacts to the herds involved >15% adult loss the first year after the pathogen spillover and variable/cyclical lamb mortality lasting 1 to 18 years. It is estimated that since 2019 over 3,000 adults died of pneumonia and innumerable lambs perished that would have normally been recruited into the population. Extensive disease surveillance and post event testing has confirmed *Mycoplasma ovipneumoniae* (*Movi*) as the "trigger" pathogen involving approximately 17 different strains. Most of the pathogen spillovers over the last decade have been bighorn to bighorn transmission.

Figure 3. Ram Harvest in Nevada by subspecies 1965 - 2023
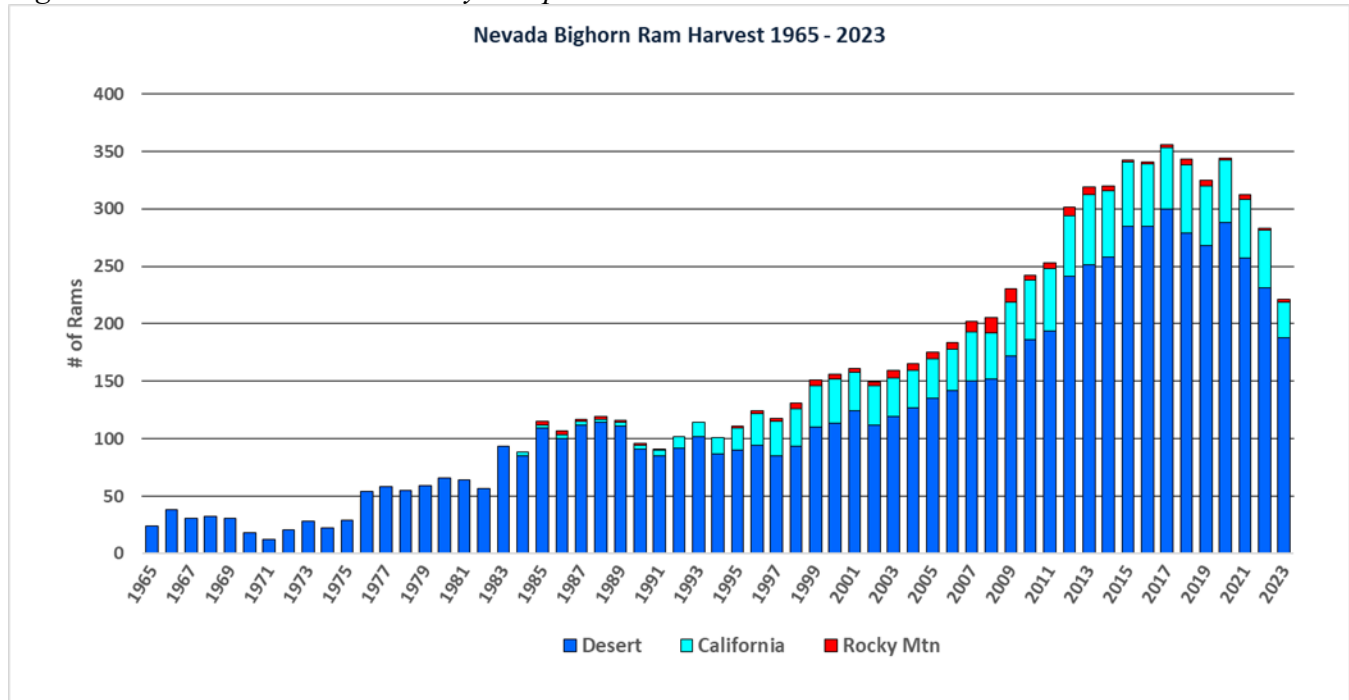
Test and Remove

Ongoing efforts continue with Test and Remove for California bighorn herds in the Santa Rosa Range and Snowstorm Mountains in northern Nevada. For the Santa Rosas, 112 bighorns have been sampled since 2021 (90% ewes) and 14 were positive for Mycoplasma ovipneumoniae (Movi) by PCR. Likely, less than 6 ewes currently alive have not been tested. For the Snowstorms, 110 animals have been sampled and tested since 2014 (68% ewes). A total of 29 were positive for Movi by PCR. Efforts will continue to monitor lamb recruitment to evaluate the hopeful success of the Test and Remove projects with the goal to augment both populations with "clean" bighorn sheep. USDA Wildlife Services has been conducting predator management for these 2 herds. There is a huge investment in Test and Remove projects, where clean/healthy ewes are "priceless" and their protection and survival is key to the future restoration of their bighorn populations. This project is in collaboration with the Oregon Department of Fish and Wildlife involving an interstate herd (Santa Rosas/Rattlesnake/Ten Mile) and part of the overall ION (Idaho/Oregon/Nevada) Partnership supported by the Wild Sheep Foundation and affiliate bighorn conservation groups in each state.

A Test and Remove project was initiated in 2021 on the Nevada Test and Training Range (NTTR, Department of Defense (DOD) lands) for a large desert bighorn metapopulation that had its pathogen spillover in 2014. It was expanded to include adjacent herds on BLM lands in 2022 with known connectivity to the NTTR bighorn population. A total of 53 animals were sampled just on the NTTR with only 3 actively shedding *Movi* (all 3 were euthanized). An additional 31 bighorn were tested from adjacent herds on BLM lands in 2022 and 2023 with only 1 actively shedding *Movi*. Based on high rates of *Movi* antibody detection from ELISA tests 2022 and 2023 of 42% and 71%, respectively, there are still chronic carriers scattered across the large metapopulation. Due to lack of funding, challenges to accessing DOD lands, low bighorn density, and limited ability to detect chronic carriers ("needle in a haystack"), the Test and Remove effort was discontinued. Periodic surveys will be conducted to see if the metapopulation can clear the active Movi infection through old-age attrition and lion predation of chronic carriers.

Figure 4. Mycoplasma ovipneumoniae (Movi) exposure status from statewide disease surveillance from 2010-2023 involving both live capture and hunter harvest sampling.
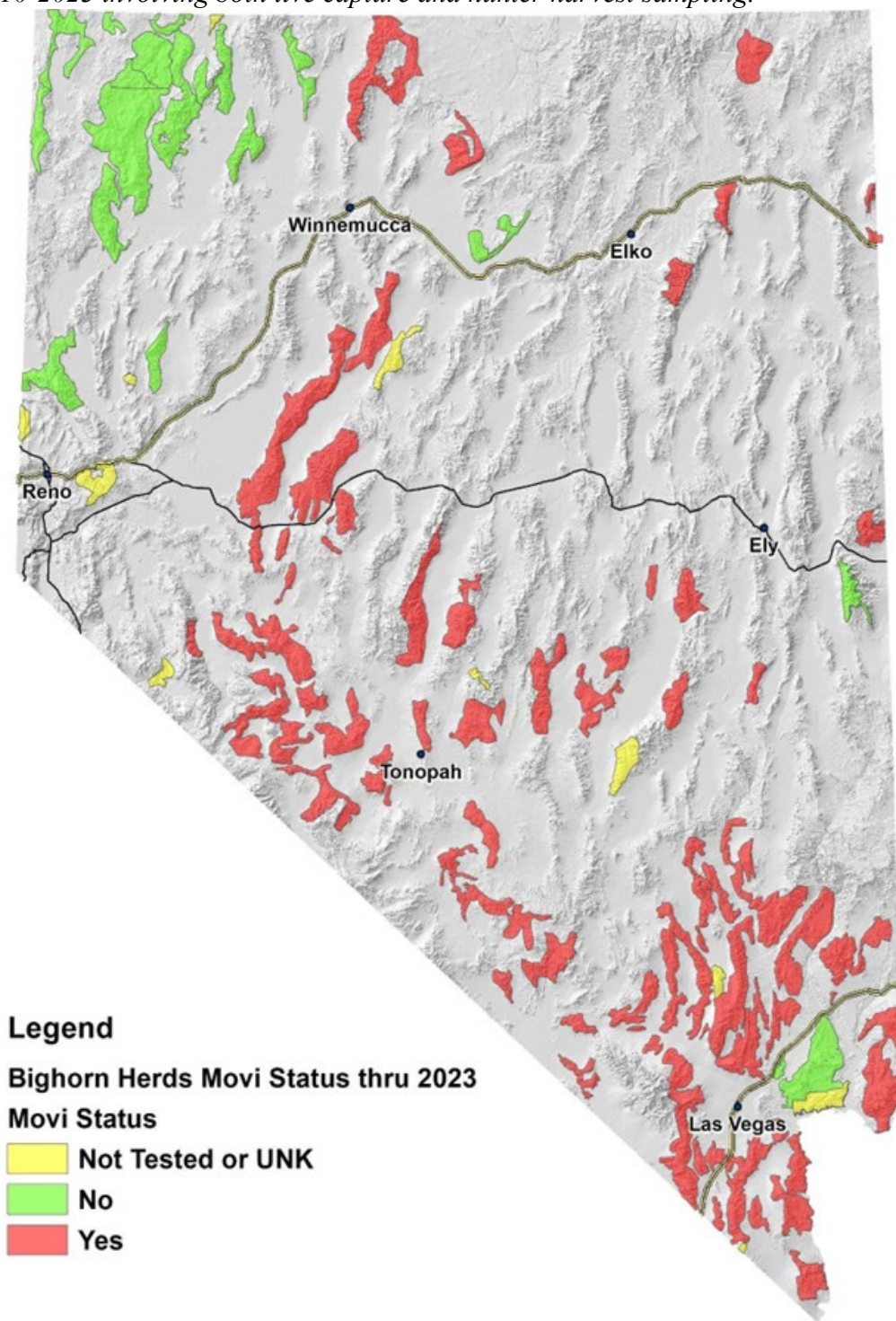
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Population Structure of North American Mountain Sheep. *In* Thomas, A.E. and H.L. Thomas (eds.). 2000. Transactions of the 2nd Northern Wild Sheep Conference. 9-16.

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Mike Cox, Nevada Department of Wildlife

New Mexico

Rocky Mountain Bighorn Sheep

Population

New Mexico has observed slight declines in the statewide estimates for both Rocky Mountain and desert bighorn subspecies over the last five years. Decreasing numbers of Rocky Mountain bighorn are in part driven by the ewe harvest program implemented in the Rio Grande Gorge from 2018-2022. The management objective was to decrease this burgeoning low elevation population that resides in close proximity to private domestic flocks of sheep and goats. Rocky mountain bighorn have been restored to all known historic habitat since their extirpation in the early 20th century and are now estimated near 1,565 (Figure 1) across 11 populations statewide. No obvious restoration sites remain, and only a few potential areas would be considered at this time. With the last translocation occurring in 2017, recent management has focused on optimizing hunter opportunity and tracking the spillover of *Mycoplasma ovipneumoniae* (M. ovi) into several naïve populations.

Figure 1. The estimated number of Rocky Mountain bighorn sheep throughout New Mexico (N).
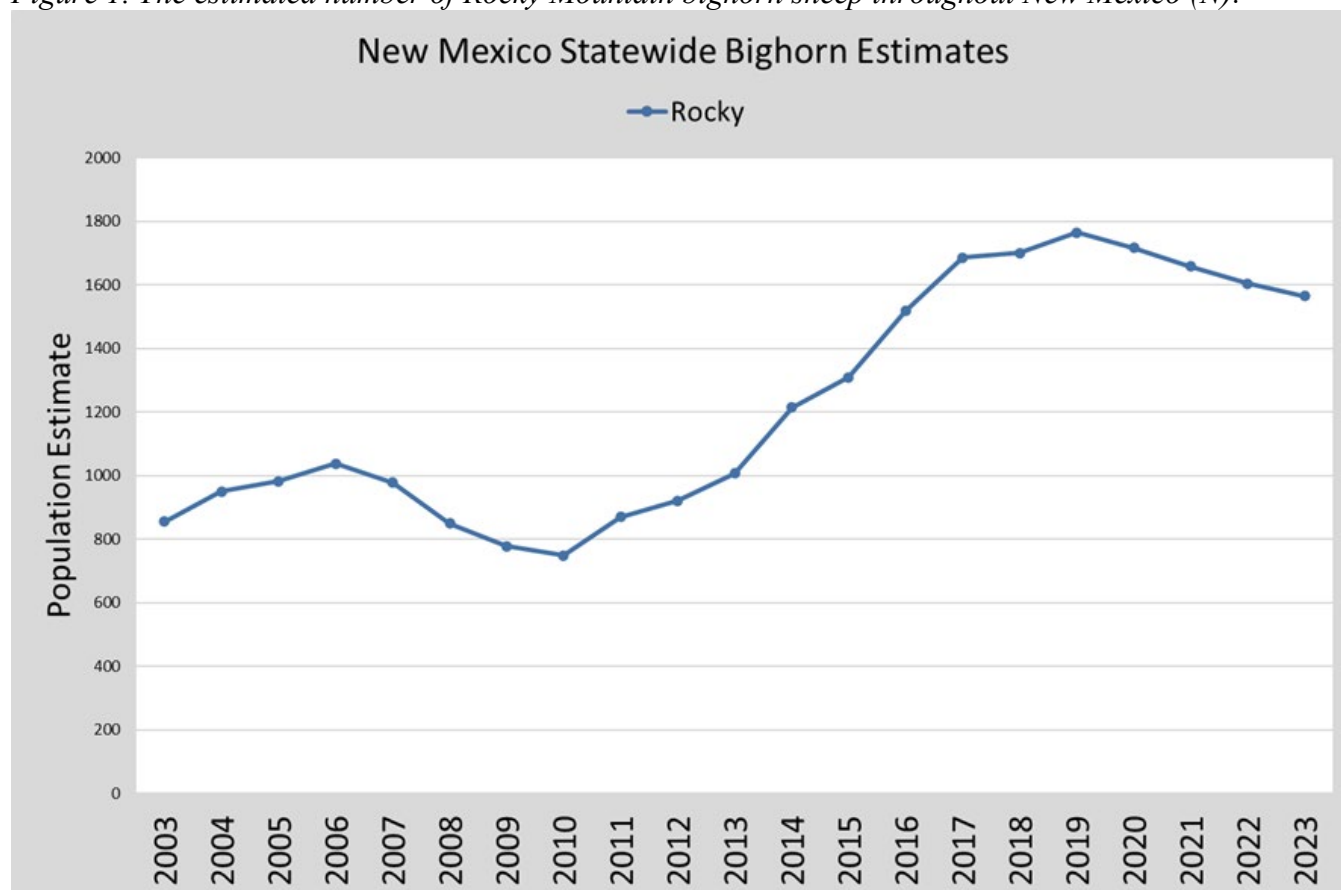
Licenses and Harvest

Rocky Mountain bighorn sheep hunts occur in the Game Management Units (GMUs) shown in blue in Figure 2. These areas represent 9 of the 11 Rocky Mountain bighorn populations, while the remaining two are not hunted. Twenty-eight ram licenses were issued in 2023 (Figure 3). A suite of metrics is used to inform ram harvest decision making throughout the state. In areas where bighorn populations use both tribal and public land, tribal harvest levels are also considered. The metrics that guide license determination for rams are 2.5% of local population size, 10% of total rams, and 25% of CIII and CIV rams. Success on ram hunts has been near perfect and averaged 96% from 2020-2023. Horn restrictions do not apply and the bag limit is defined as any ram. The average age of Rocky Mountain bighorn rams harvested in 2023-2024 was 8.7.

Figure 2. New Mexico bighorn sheep hunts occur in the outlined GMUs, with orange boundaries indicating desert bighorn hunt units and blue boundaries indicating Rocky Mountain bighorn hunt units.
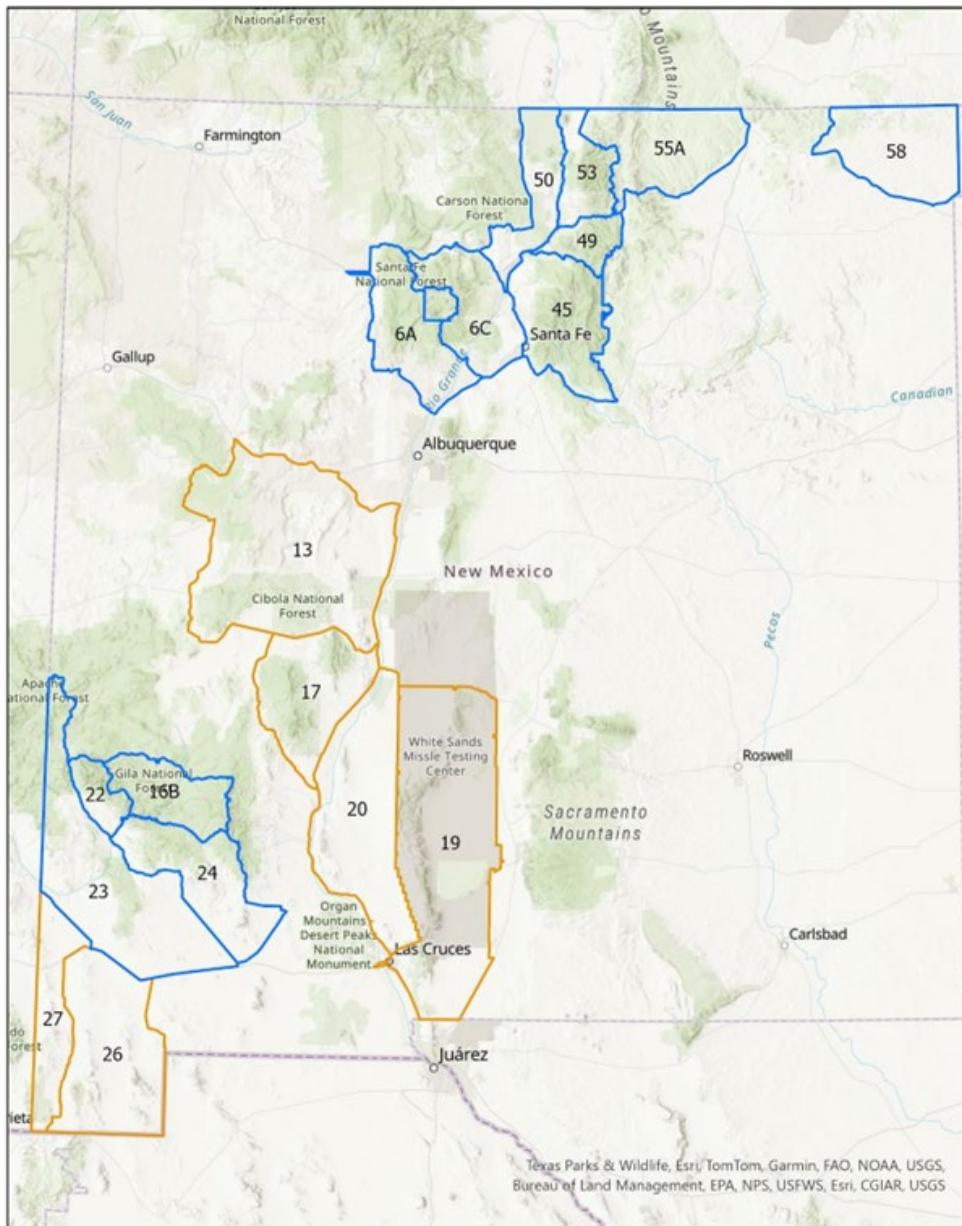
Management ewe hunts for Rocky Mountain bighorn sheep were initiated in 2011 in the Latir Mountain herd, but ewe hunting has been limited to the Pecos and Rio Grande Gorge populations in recent years with 58 licenses issued in 2022 (Figure 4). The management ewe hunt in the Rio Grande Gorge was suspended for the 2023-2024 season in response to decreased lamb:ewe ratios following an M. ovi spillover in 2020. Thirty ewe licenses were issued for the Pecos in 2023. Ewe harvest data is not yet available for the 2023-2024 season, however success rates on ewe hunts declined from ~ 75% since 2018 to ~ 60% in 2022. The number of ewe hunting licenses issued varies with population size and herd objective but has averaged around 21% of the estimated ewe segment resulting in a harvest rate averaging 11%.

Figure 3. The total number of ram licenses issued annually for Rocky Mountain bighorn sheep and harvest rate as a percentage of the statewide estimate (N).
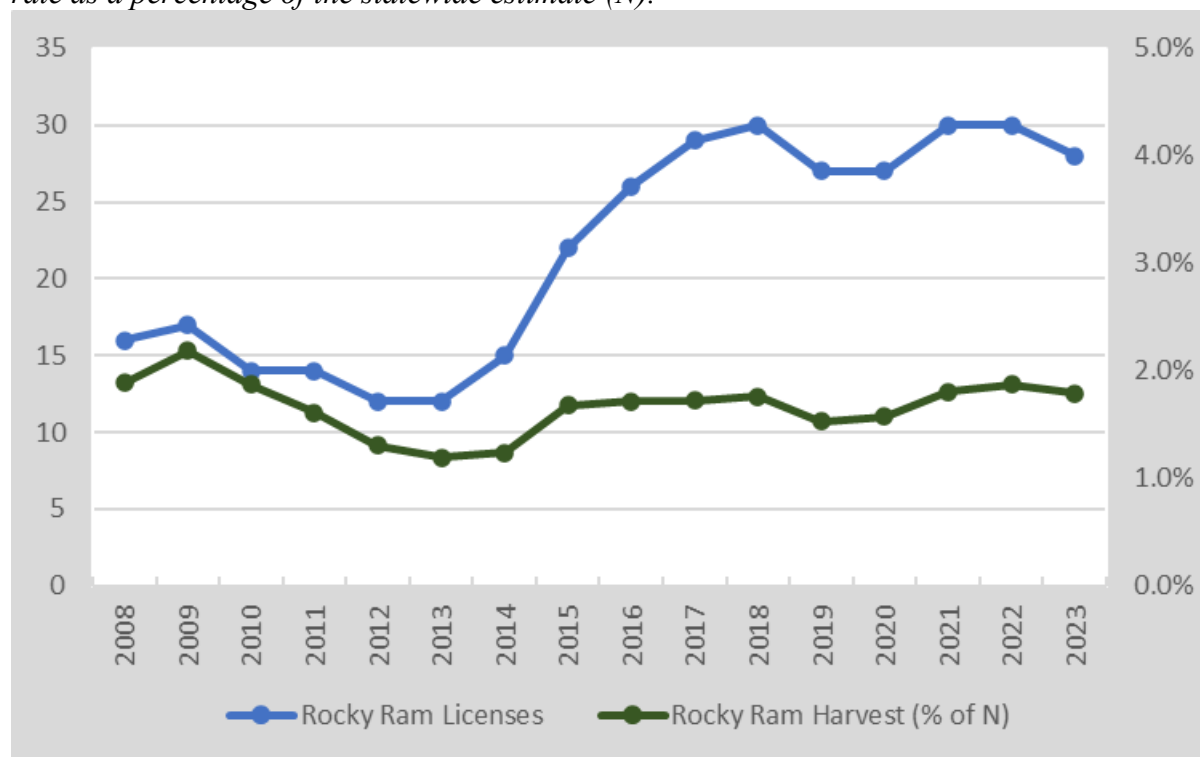
New Hunt for 2024
Beginning in 2024, 2 new ram licenses will be issued for the Jemez population (GMUs 6a/6c). This herd was reintroduced to historic habitat in 2014. An additional augmentation of 33 bighorn occurred in 2017. Opening this population for hunting follows New Mexico's track record of waiting ~10 years from reintroduction to opening harvest to allow for the age structure to settle. The Jemez population is surveyed annually. As of 2023 the population is estimated to be 150-200 individuals and has been stable over the last 3-5 years. Lamb:ewe ratios for 2022 and 2023 were 61:100 and 29:100, respectively.

Disease and herd health
In 2022, a ram mortality in the Red River population uncovered the spillover of M. ovi into this herd since previous testing done in 2017 and 2020 was negative for exposure. A collaring effort ensued here in March 2022 to facilitate monitoring a potential outbreak. M. ovi was also discovered for the first time in the Wheeler Peak herd, coinciding with the observation of 10-15 overwinter carcasses and symptomatic sheep observed in July 2022, yet that July aerial survey resulted in one of the highest counts

in recent years with a minimum of 200 bighorn observed. Notable changes in lamb:ewe ratios were observed in the Rio Grande Gorge (11:100) and Wheeler Peak herds (14:100).

Figure 4. The total number ewe licenses issued annually for Rocky Mountain bighorn sheep and harvest rate as a percentage of the statewide estimate (N).

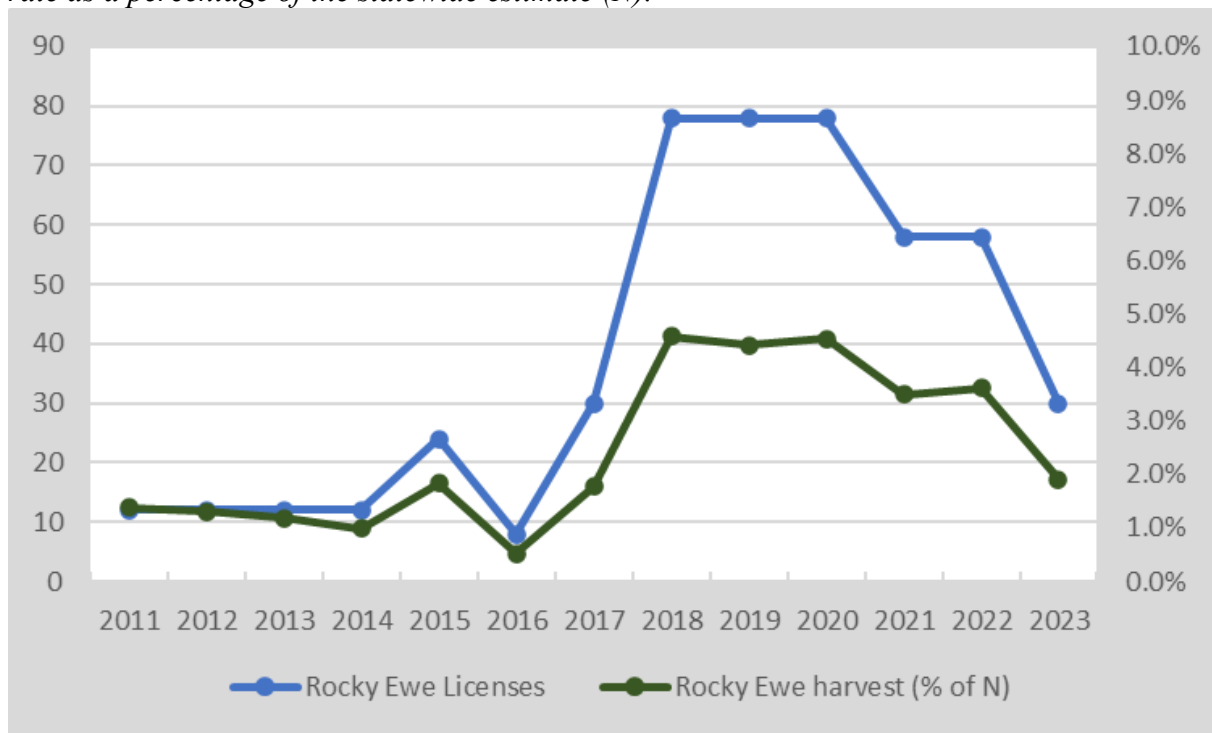As of 2023, the minimum count for the Wheeler Peak herds indicates that the decline has not been extreme but noticeable as it is the lowest known minimum (resulting from combined ground and air efforts) since 2015. The change in the minimum known is 25%. In the summer of 2022, the known adult mortalities reported were 7 rams and 2 ewes. In the summer of 2023, outfitters and guides reported approximately 15 dead ram and 15 ewe carcasses that were apparently from last year. There may be some overlap in these numbers as not all ram heads were retrieved. Darting and collaring efforts began in 2023 to increase monitoring in Wheeler, however darting in the area is slow-going and limited by season. Deploying collars in the region remains a high priority for management. Capture and harvest testing in Fall/Winter of 2023 detected a few individuals with antibodies present, but no active infections were detected.

Desert Bighorn Sheep
Population
The status of desert bighorn has improved since their state endangered delisting in 2011 and the statewide population appears to be stable following a slight decline in 2019 (Figure 5). As of 2023, lion predation continues to be a leading cause of mortality in desert bighorn despite ongoing removal efforts within most desert bighorn ranges. Translocations to augment existing herds or restore populations continue. Most recently, desert bighorn were restored to the Alamo Hueco mountains in the "Bootheel" region of southwestern New Mexico in 2021. A second release of 28 individuals took place in the Alamo Huecos in October 2023 and as of February 2024 there have been no documented mortalities of translocated and radio collared individuals. Other vacant desert bighorn habitat remains on the landscape. With a few potential restoration sites remaining, harvest of desert bighorn ewes is not currently being considered.

Figure 5. The estimated number of desert bighorn sheep throughout New Mexico (N).
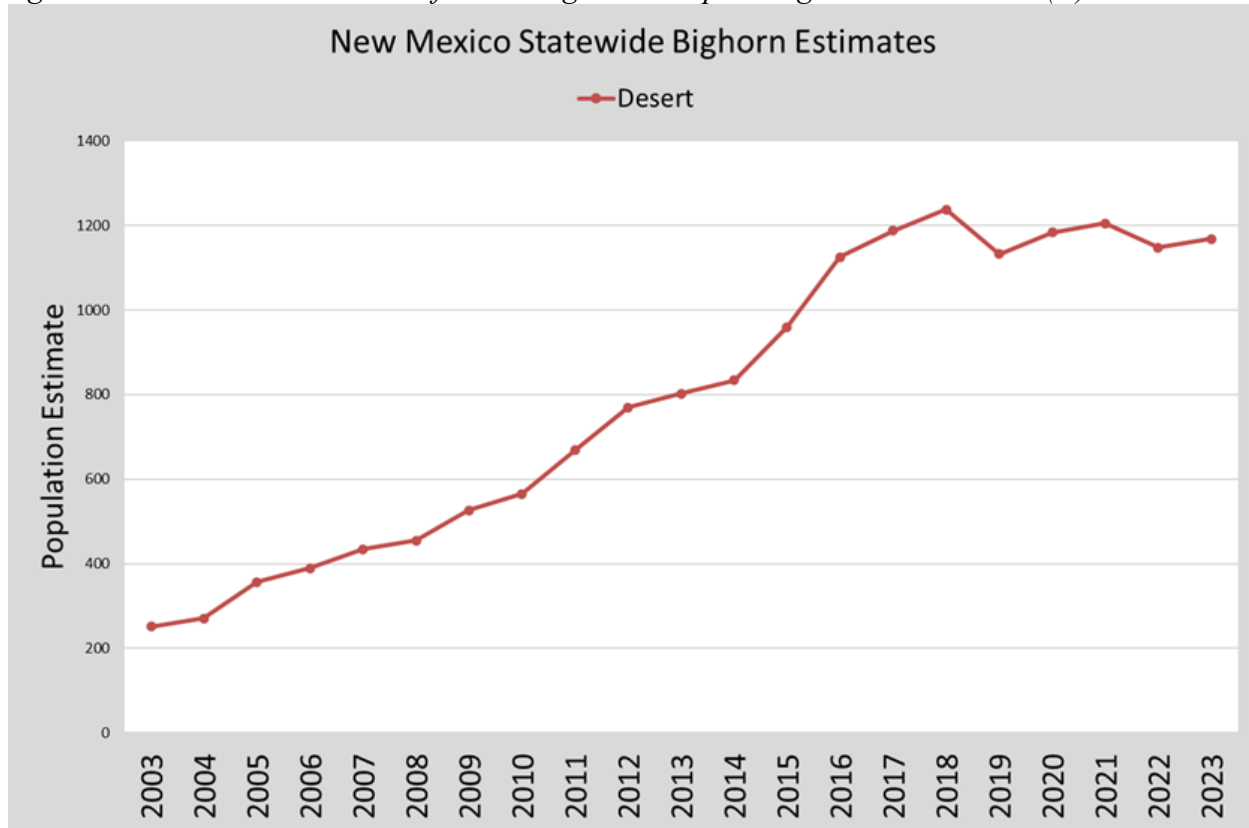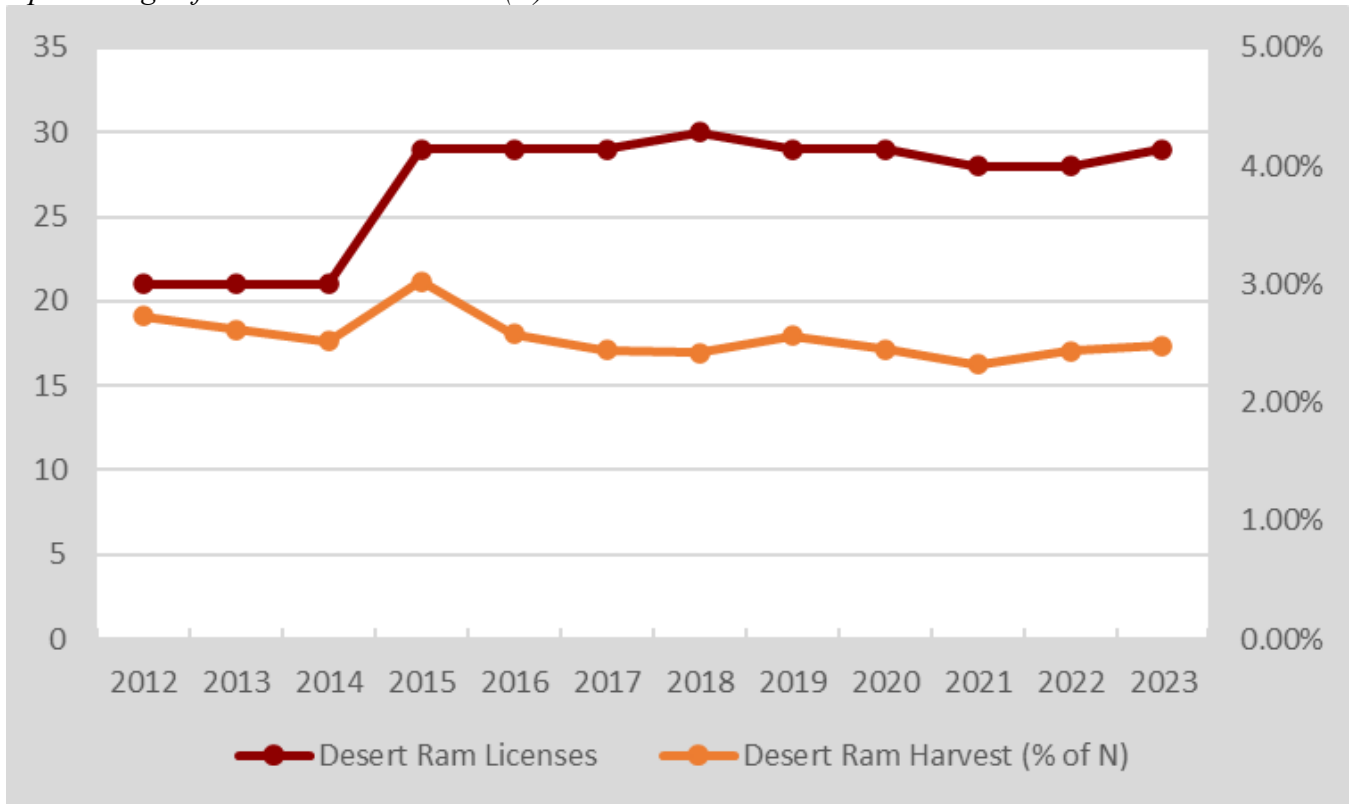

Figure 6. The total number of ram licenses issued annually for desert bighorn sheep and harvest rate as a percentage of the statewide estimate (N).

Licenses and Harvest

Desert bighorn sheep hunts occur in the GMUs shown in orange in Figure 2. These areas include 8 of the 9 desert bighorn populations, with one not hunted. Twenty-nine ram licenses were issued in 2023 (Figure 6). As with the Rocky Mountain subspecies, the metrics that guide license determination for desert rams are 2.5% of population size, 10% of total rams, and 25% of CIII and CIV rams. Success on ram hunts has averaged 100% from 2020-2023. Horn restrictions do not apply and the bag limit is defined as any ram. The average age of desert bighorn rams harvested in 2023-2024 was 9.

Disease and herd health

Prior to 2017, M. ovi had only been documented in the San Andres desert bighorn population. In 2022, M. ovi was documented in four additional herds, including those adjacent to the San Andres and those in the central geographic region of New Mexico. No new disease events or pathogen detections occurred for desert bighorn in 2023. Of the populations surveyed, average Spring lamb:ewe ratios were identical (50:100) for central herds and Bootheel herds, however only 2 of the 5 central herds were surveyed this Spring. In 2022, Spring lamb:ewe ratios were lower in the central herds (17:100) and higher in the Bootheel herds (59:100) compared to recent averages.

Katie Piecora, New Mexico Department of Game & Fish

North Dakota

Rocky Mountain Bighorn Sheep

Populations

The North Dakota Game and Fish Department's 2023 bighorn sheep survey, completed by recounting lambs in March, revealed a record 364 bighorn sheep in the Little Missouri National Grassland of western North Dakota, up 5% from 2022 and 16% above the five-year average. The 2023 survey was the fourth consecutive record total and surpassed the previous record of 347 bighorns in 2022.

The 2023 survey saw an increase in the state's population for the sixth consecutive year. Altogether, biologists counted 106 rams, 202 ewes and 56 lamb (Figure 1). Not included are approximately 40 bighorn sheep in the North Unit of Theodore Roosevelt National Park and 80 bighorn sheep in the Fort Berthold Indian Reservation.

Figure 1. Population change not including populations at Theodore Roosevelt National Park and Fort Berthold Reservation.
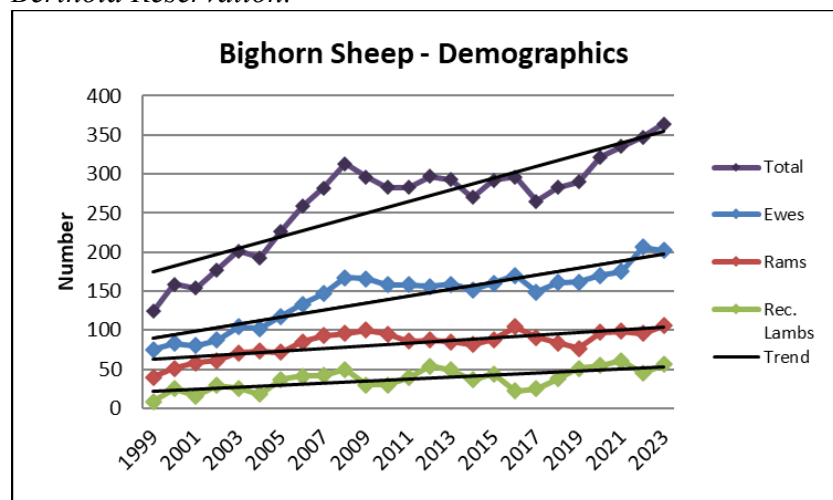
The northern badlands population increased 5% from 2022 and was the highest count on record. The southern badlands population dropped to the lowest level since bighorns were reintroduced there in 1966.

Adult rams were at a record level and adult ewes and lambs were near record numbers. Unlike the population declines observed in most other big game species following the severe winter of 2022-2023, the increase in the bighorn population was attributable to two factors: higher than expected survival of adults and lambs during the extreme winter conditions of 2022, and better than anticipated lamb production and survival during 2023. The lamb recruitment rate (lambs/adult ewe) was 31% and there were 52 rams per hundred ewes.

Department biologists count and classify all bighorn sheep in late summer, and then recount lambs the following March, as they approach 1 year of age, to determine recruitment.

Department staff, in conjunction with biologists from the Three Affiliated Tribes Fish and Wildlife Division, also reported the bighorn sheep translocated in January 2020 from Rocky Boy's Reservation in Montana to the Fort Berthold Reservation have nearly tripled in number since their release.

There are currently about 490 bighorn sheep in the populations managed by the North Dakota Game and Fish Department, National Park Service and the Three Affiliated Tribes Fish and Wildlife Division.

Department staff were encouraged by the results of the 2023 survey considering the severity of the 2022-23 winter.

Licenses and Harvest
A bighorn sheep hunting season is tentatively scheduled to open in 2024.The status of the season will be determined September 1, following the summer population survey. Game and Fish issued five licenses in 2022 and all hunters were successful in harvesting a ram. A total of 264 bighorn rams have been harvested in North Dakota since 1975, with a success rate of 98%. A record 19,423 applicants applied for a lottery license in 2022, including 314 non-residents.

Test & Remove
North Dakota experienced a significant epizootic in 2014. *Movi* was detected in 100% of mortalities. Despite the population currently at record numbers, animals that test positive via PCR during annual winter capture and collaring operations are euthanized. No detections occurred during 2021 and 2022.

Brett Wiedmann, North Dakota Game and Fish Department

Northwest Territories
Not Available

Oregon
Rocky Mountain Bighorn Sheep
Population
Oregon currently has 11 Rocky Mountain bighorn sheep herds (Figure 1), three of which are viable. All extant Oregon herds are the result of re-introductions. Since the first successful release of 20 animals from Alberta, Canada in the Lostine River in 1971, 31 additional releases of 410 animals from 7 state or provinces including Alberta, British Columbia, Colorado, Idaho, Montana, and Oregon have occurred. Release size has averaged 13 but has ranged from a low of 2 or 3 animals to as high as 29 animals.

Figure 1. Occupied bighorn ranges in Oregon.
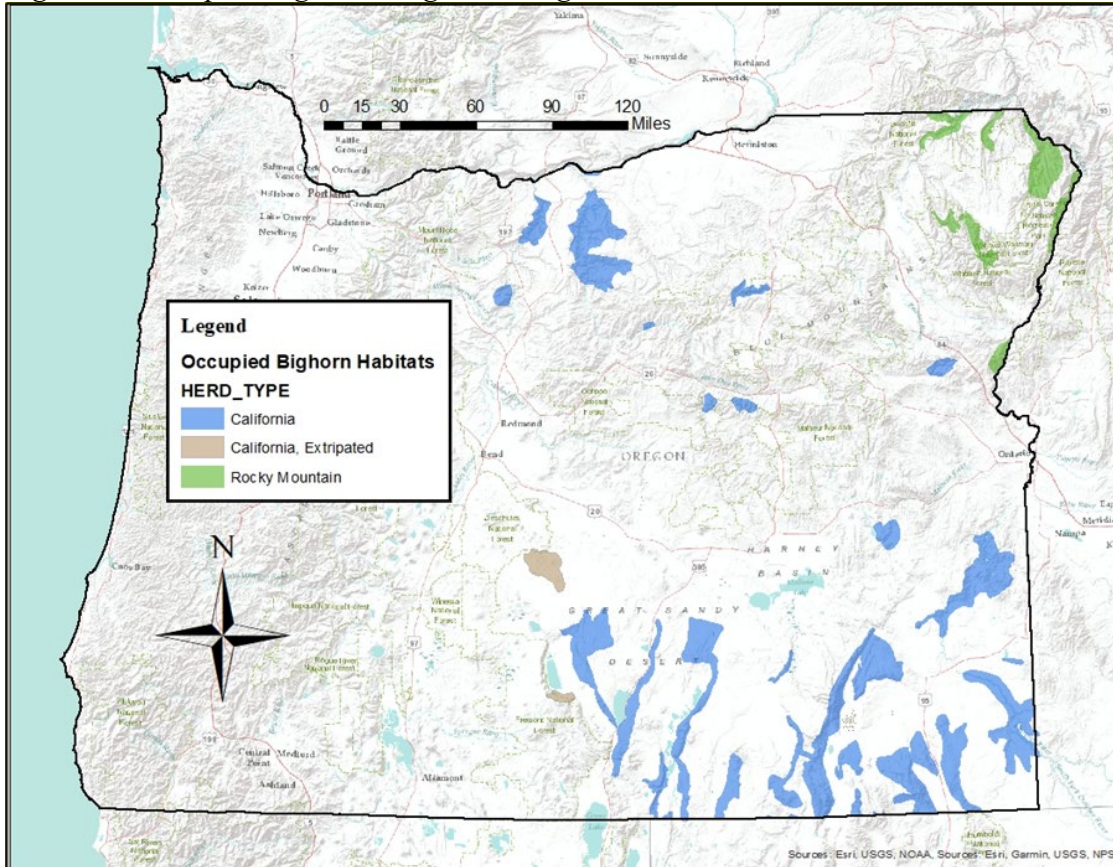
The combined annual population estimate for Rocky Mountain bighorns in Oregon has averaged 600–900 animals over the last 22 years (Figure 2) with a 2023 estimate of around 1,100 animals. Fluctuations are primarily the result of pneumonia induced, die-offs followed by variable degrees of population recovery. There are currently two Rocky Mountain bighorn populations with active Mycoplasma ovipneumonia (M.ovi.) induced mortality.

Figure 2. Recent population trend of Rocky Mountain and California bighorn sheep in Oregon, 2001 – 2023.
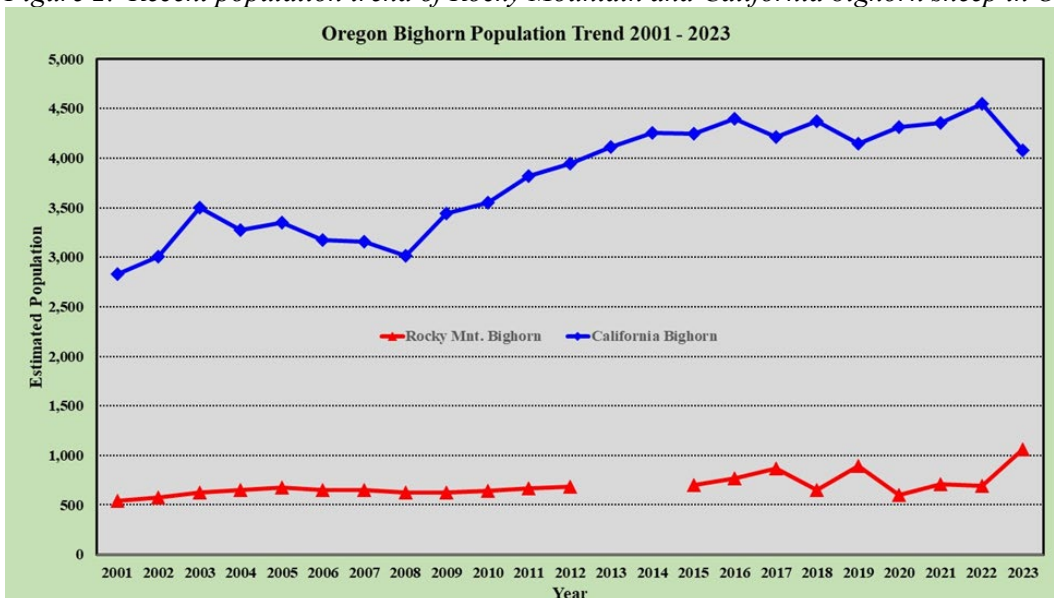
Harvest

Since Oregon began hunting Rocky Mountain bighorns in 1978, over 400 animals have been taken. Harvest has been primarily rams. Since 2001, an average of 9 controlled tags, 1 special auction tag, and 1 special raffle tag are allocated annually (Figure 3). Annual average harvest is 11 rams annually but has declined in response to disease induced population declines. Harvest analyses for 2023 had not been summarized at the time of writing.

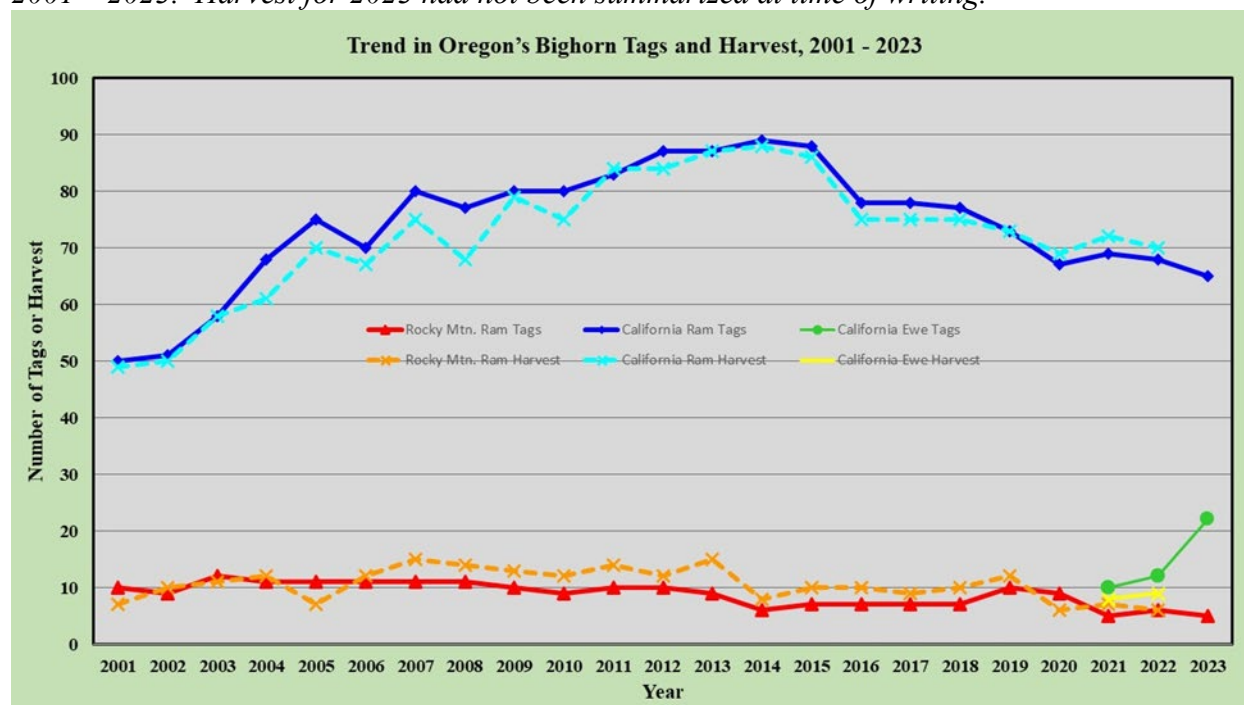*Figure 3. Recent trend of Rocky Mountain and California bighorn sheep tags and harvest in Oregon, 2001 – 2023. Harvest for 2023 had not been summarized at time of writing.*

California Bighorn Sheep

Oregon currently has 32 extant herds of California bighorn sheep (Figure 1), all of which are the result of reintroductions. Since the first successful release of 20 animals from British Columbia, Canada on Hart Mountain National Antelope Refuge, 98 additional relocations of 1,343 California bighorns from Oregon have occurred. Seventy-one of these releases (1,009 animals) were conducted within Oregon and Twenty-seven relocations (334 animals) were in 4 other jurisdictions (Idaho, Nevada, Washington, Wyoming).

The combined annual population estimate for California bighorns in Oregon has averaged about 3,800 animals in recent years (Figure 2) with a 2023 estimate of 4,100 animals. Fluctuations are primarily the result of pneumonia-induced die-offs followed by variable degrees of population recovery. At time of writing 4 distinct herds are experiencing M.ovi. induced mortality.

Harvest

Since Oregon began hunting California bighorns in 1965, nearly 3,000 animals have been taken. Harvest has been primarily rams, but ewe harvest began in two herds beginning in 2021. Since 2001, an average of 74 controlled ram tags are allocated annually (Figure 3). Ten and 12 ewe tags were allocated in 2021 and 2022, respectively. Annual average harvest is 72 rams annually. Harvest analyses for 2023 had not been summarized at the time of writing.

Disease Management

Oregon is currently conducting test and remove operations in 4 bighorn populations. Pneumonia induced by M.ovi. was first detected in the Rattlesnake-Tenmile California bighorn herd in southeastern Oregon in 2012, with detection of mortalities beginning in 2015. During late winter 2019-2020, M. ovi. induced pneumonia was detected in the Lookout Mountain herd of Rocky Mountain bighorns along the Snake River in northeastern Oregon. By fall of 2020 the disease had crossed Interstate 84 to the west and M.ovi. was detected in the Burnt River California bighorn herd. In January 2024 M.ovi. also was detected in the lower Snake River herds. Because of the connections among these herds in three state (Oregon, Idaho, and Washington), all three states are paying extra attention to wild sheep in this area.

Test and remove operations began in the Lookout Mountain, Burnt River, and Rattlesnake-Tenmile herds during winter 2021-2022. Test and remove began in the Lower Owyhee herd beginning winter 2023-2024. In the Rattlesnake-Tenmile herd, animals were removed after a single positive M.ovi. test. Two or more positive tests is required for removal in all other test and remove herds.

Don Whittaker, Oregon Department of Fish & Wildlife

South Dakota

Rocky Mountain Bighorn Sheep

Populations

The Rocky Mountain Bighorn Sheep (RMBS) population consists of 6 herds totaling approximately 370 sheep scattered throughout western SD. Bighorn sheep were numerous on the prairies of western SD and the Black Hills before their extirpation in the late 1890s. United States Senator Peter Norbeck orchestrated their reintroduction in the early 1920s and this began a conservation success story where bighorns once again occupied their native habitats in SD. Unfortunately bighorn populations have fluctuated greatly since their reintroduction in the 1920s most likely due to pneumonia related mortality. In 2023, there were estimated 370 RMBS in SD (Figure 1).

Figure 1. Population trend, 2014 – 2024.
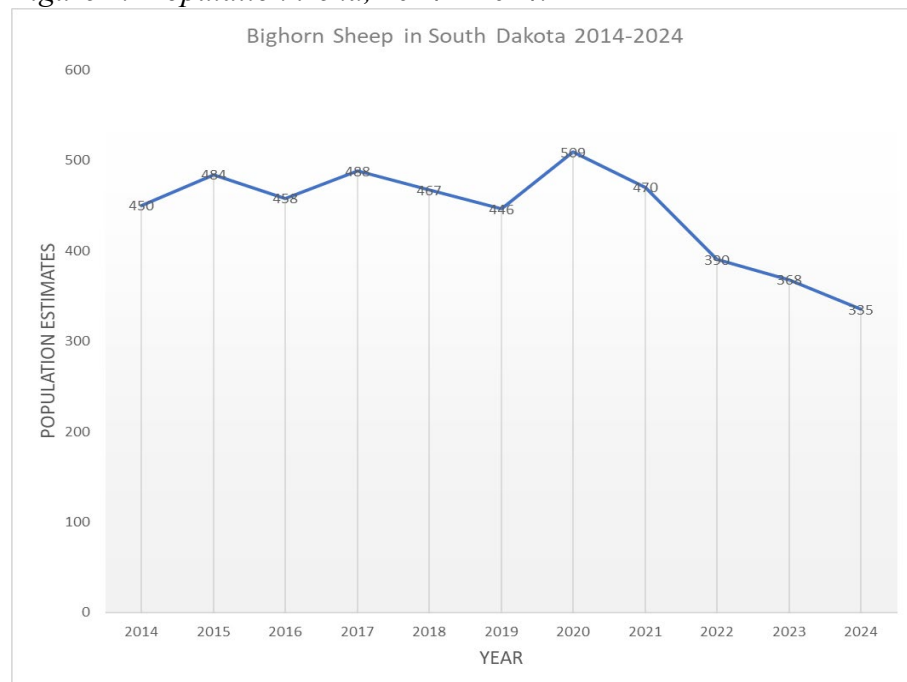
Licenses and Harvest
Going back to 1978 licenses offered have varied from 2 to 11. Harvest since 1978 has been at a success rate of 100%. Permits typically consist of 1 auction permit and several South Dakota resident random draw permits. Rams are only allowed for harvest. Ewes hunts can be implemented when deemed necessary.

Test & Remove
Unfortunately researchers in SD have documented bighorn disease die-offs in 4 populations related to pneumonia from *Mycoplasma Ovipneumoniae* (*Movi*) since 2004. To recover these populations SD has implemented the Test and Remove method in all 4 populations. In 2 of the populations (Custer State Park and Rapid City herds) this method has successfully removed the *Movi* pathogen and allowed lamb survival to recover to normal levels. In the most recent population (Badlands) Test and Remove was just initiated in 2023. The Test and Remove method was important in reducing pneumonia related mortality in both adults and lambs and allowed recovery in 2 populations (Garwood et al. 2020, Ensrud 2022, SDGFP unpublished data).

Literature Cited
Garwood, T., C. P. Lehman, D. P. Walsh, E. F. Cassirer, T. E. Besser, J. A. Jenks. 2020. Removal of chronic *Mycoplasma ovipneumoniae* carrier ewes eliminates pneumonia in a bighorn sheep population. Ecology and Evolution 10(7):1-12.

Ensrud, A. N. 2022. A post-pneumonia epizootic evaluation of the Rapid City, South Dakota bighorn sheep herd. M.S. Thesis, South Dakota State University, Brookings, SD, USA.

-Chad Lehman, South Dakota Department of Game, Fish, and Parks

Texas

Desert Bighorn Sheep

Population
Historically, desert bighorn sheep occupied 15-16 mountain ranges in the Trans-Pecos Region of Texas and numbered around 1,500-2000. However, by the early 1960s the native Texas desert bighorns had been extirpated. Desert bighorns from various states, including Nevada, Arizona, Utah and Baja California (Mexico), were brought into Texas to help with captive propagation and restoration efforts.

These efforts resulted in population growth to approximately 1,500 animals in 11 of their historic mountain ranges, where the population estimate remained for several years. In the last 4 years the Texas population has been in decline and the statewide estimate is approximately 600 animals (Figure 1). This decline is largely attributed to disease impacts.

Disease and Herd Health
There have been at least three known disease events in Texas. The first known disease event was detected in the Fall 2019 in one population (Van Horn Mountains), followed by another in the Spring 2020 in a distinct population (Black Gap Wildlife Management Area). More recently, in the summer of 2023 a disease event was detected in the Sierra Diablo Mountains population. *Mycoplasma ovipneumoniae* was found in all three disease events.

The Black Gap population appears to have stabilized since the 2020 disease event with counts of 126, 117 and 127 in 2021, 2022 and 2023, respectively. The Van Horn Mountains' population is still struggling

and even though no animals were observed during the 2023 surveys, there have been a few animals (approximately 15) observed since the survey. The disease event appears to be ongoing in the Sierra Diablo population. The count in 2023 was 172 animals, which is considerably less than the 2022 count of 339. Close monitoring continues in all three populations.

There have been population declines in four other populations including Beach Mountains, Baylor Mountains, 9 Point Mesa and Big Bend Ranch State Park. Though the cause is unknown, disease is suspected. Investigations into possible causes are planned for the near future.

Figure 1. 2002-2023 Statewide desert bighorn sheep survey summary.
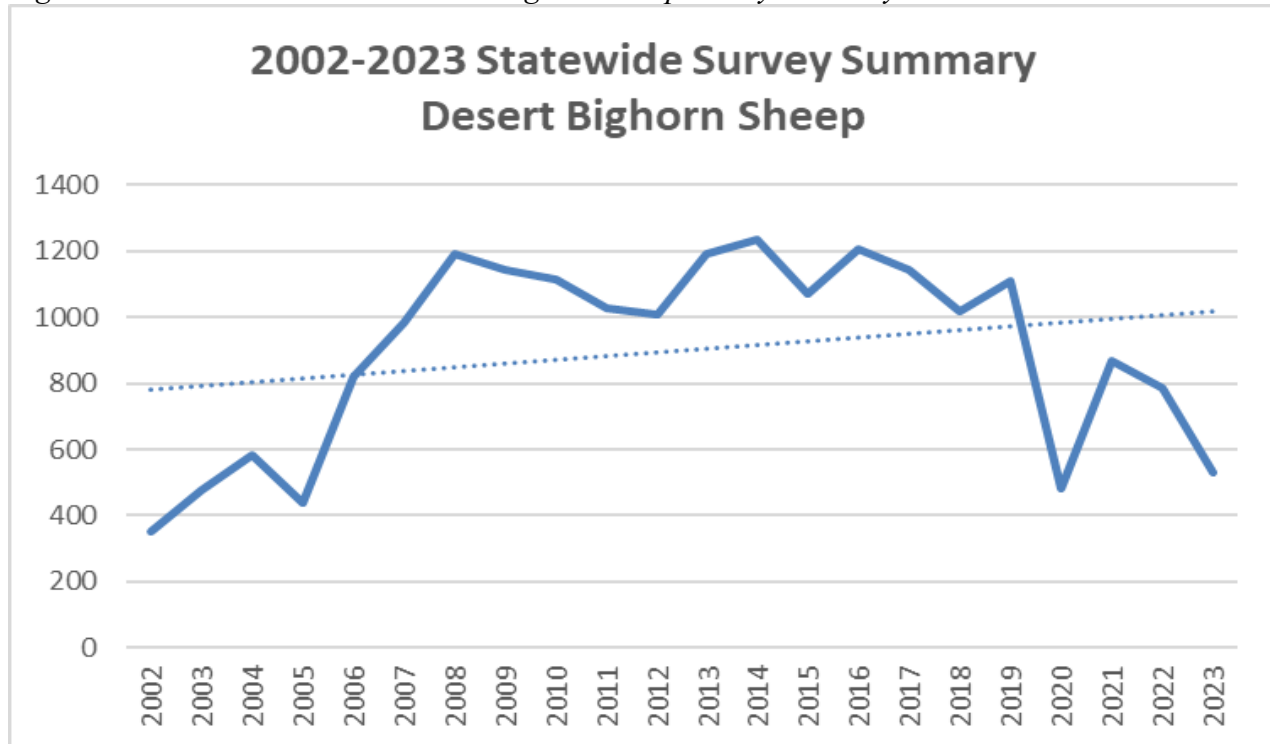
Licenses and Harvest
In 2018, the permit issuance and allocation system was changed from the system that had been in place since the late 1980s when desert bighorn hunting was reinstated in Texas. This change, which issues no more than 20% of the standing Class IV rams observed at time of survey, promoted the increase of permits and maximized hunting opportunities.

Since 2018, a total of 89 permits have been issued. Of those, 69 permits were issued to private landowners, and 17 to the State (auction and public draw system) with a 92% success rate. Due to the recent disease events and population decline, only 4 permits were issued in the 2023-2024 hunting season, which ends on the last day of July.

Test & Remove
Though Texas has not conducted Test and Remove operations, the department is considering implementing this along with other disease management strategies.

*-Froylán Hernández, Texas Parks and Wildlife Department*

Utah

Rocky Mountain Bighorn Sheep

Populations

Utah's post-hunt population of Rocky Mountain bighorn sheep (RMBHS) including California bighorn is estimated at approximately 1650 individuals (Figure 1) and has grown from approximately 700 individuals 25 years ago. Since 1966, over 1200 RMBHS have been transplanted during 60 translocations. All RMBHS populations in the state are a result of translocations from British Columbia, Nevada, Colorado, Wyoming, Alberta, and Montana. The most recent RMBHS transplant occurred in October 2022 in which Utah Division of Wildlife Resources partnered with Arizona Game and Fish Department to translocate 27 RMBHS from Morenci, AZ to Antelope Island, UT.

Figure 1. Rocky Mountain bighorn sheep population estimate in Utah
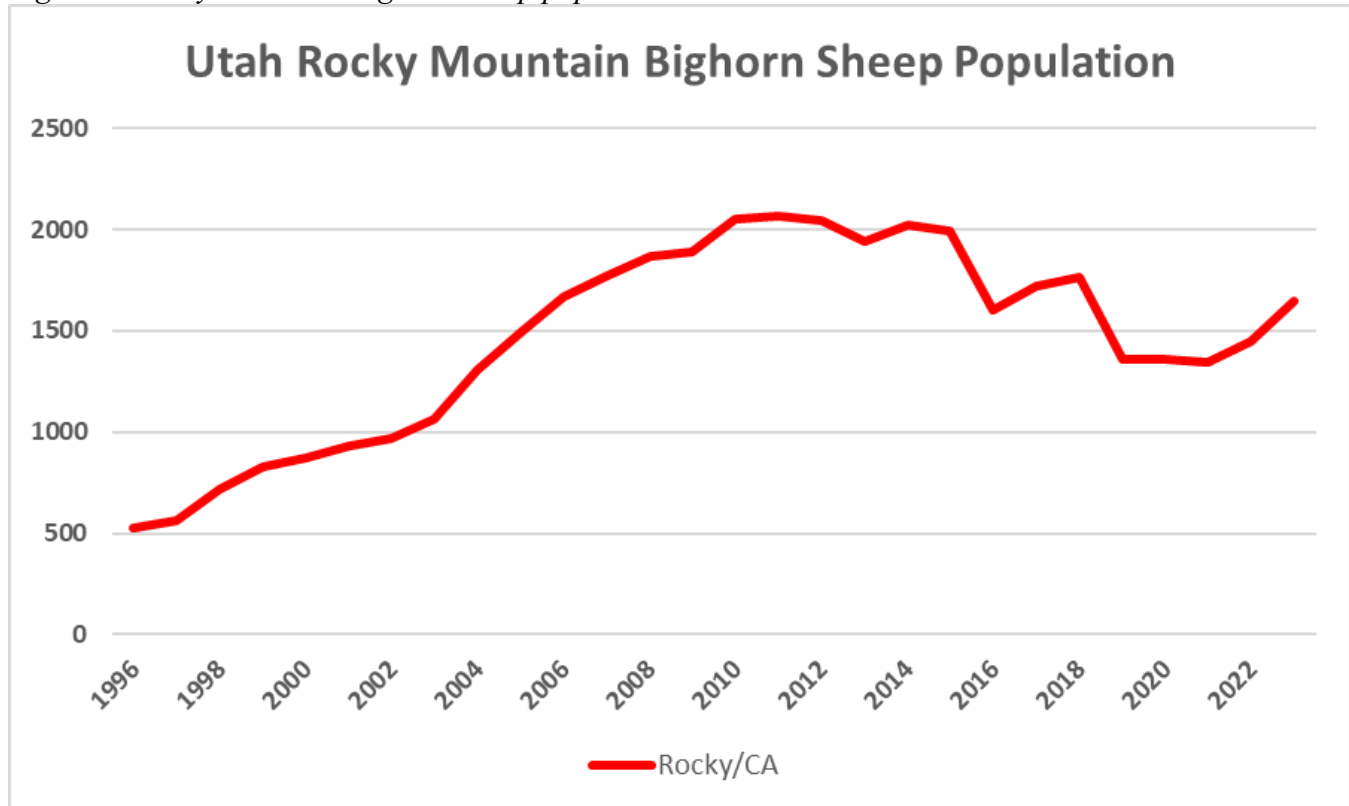
Licenses and Harvest

Utah has 14 public draw hunts on 10 different management units with occupied habitat shown in blue in Figure 2. For 2023, public draw RMBHS ram permits were reduced from 57 to 52. Five RMBHS ewe permits were also issued, which is the same as 2022.

Disease and Herd Health

During the 2023 capture season, 102 RMBHS were captured and sampled for disease surveillance. In addition, sampling kits were mailed to all permit holders to collect samples from harvested bighorns. No new all-age die-off events were detected, although disease has been identified as a limiting factor on many units throughout the state. In 2023, UDWR collaborated with Utah Department of Agriculture and Food (UDAF) to hire an interagency sheep outreach coordinator tasked with working with landowners and permittees at a statewide level to reduce disease risk in prioritized areas. Multiple potential spillover events have been prevented as a direct result of this position.

Test and Remove

No test and remove efforts have been implemented to date. However, this management tool will be considered in response to any documented disease outbreaks in populations that may be conducive and receptive to a test and remove effort.

Figure 2. Occupied bighorn sheep habitat in Utah.
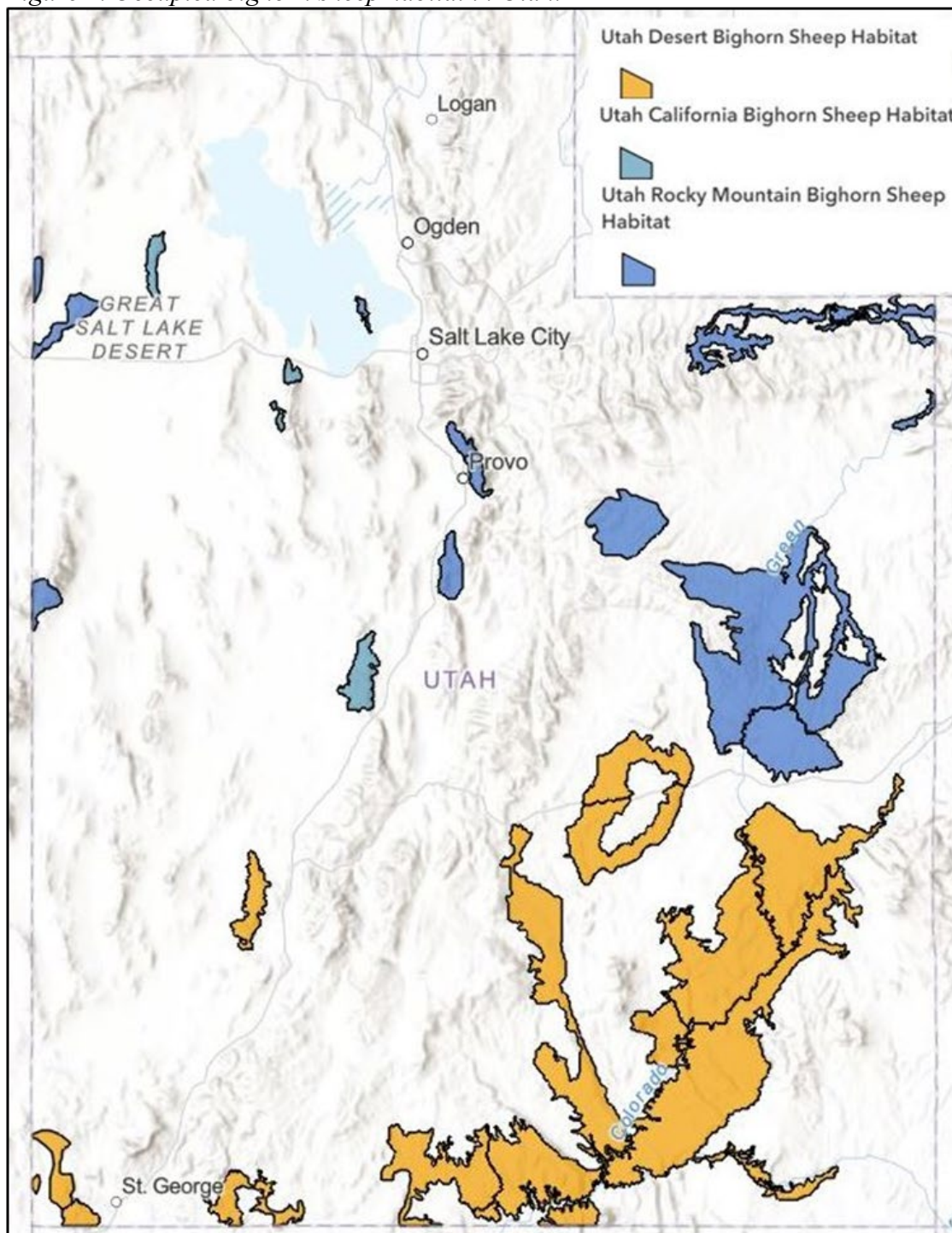
Desert Bighorn Sheep

Populations

Utah's desert bighorn sheep (DBS) population is estimated at approximately 3300 individuals statewide (Figure 3) and is a result of over 70 transplants since 1973. Over 1100 DBS from Arizona, Nevada, and from within Utah have been translocated. One of the most recent translocation efforts occurred in 2019 when the UDWR partnered with Nevada Department of Wildlife (NDOW) to reintroduce 51 bighorns from the Muddy Mountains, NV to the Mineral Mountains near Milford, UT. In 2023, the Utah Wildlife Board approved to begin hunting the Mineral Mountains unit in 2024. In June of 2022, UDWR again partnered with NDOW to translocate 31 bighorns from Valley of Fire, NV to a nursery facility near Tabiona, UT. A new nursery facility was then established on Promontory Point, UT where the nursery herd was moved in December 2023. The nursery facility is ~1100 acres, is equipped with a secure double fence and designed to keep a population of desert bighorns free from disease to be used for future translocations throughout Utah and elsewhere.

Figure 3. Desert bighorn sheep population estimate in Utah.

Licenses and Harvest

Utah has 16 public draw hunts on 15 different management units with occupied habitat shown in orange in Figure 2. For 2023, public draw DBS ram permits were increased from 71 to 75. There are no ewe hunts established for DBS in Utah.
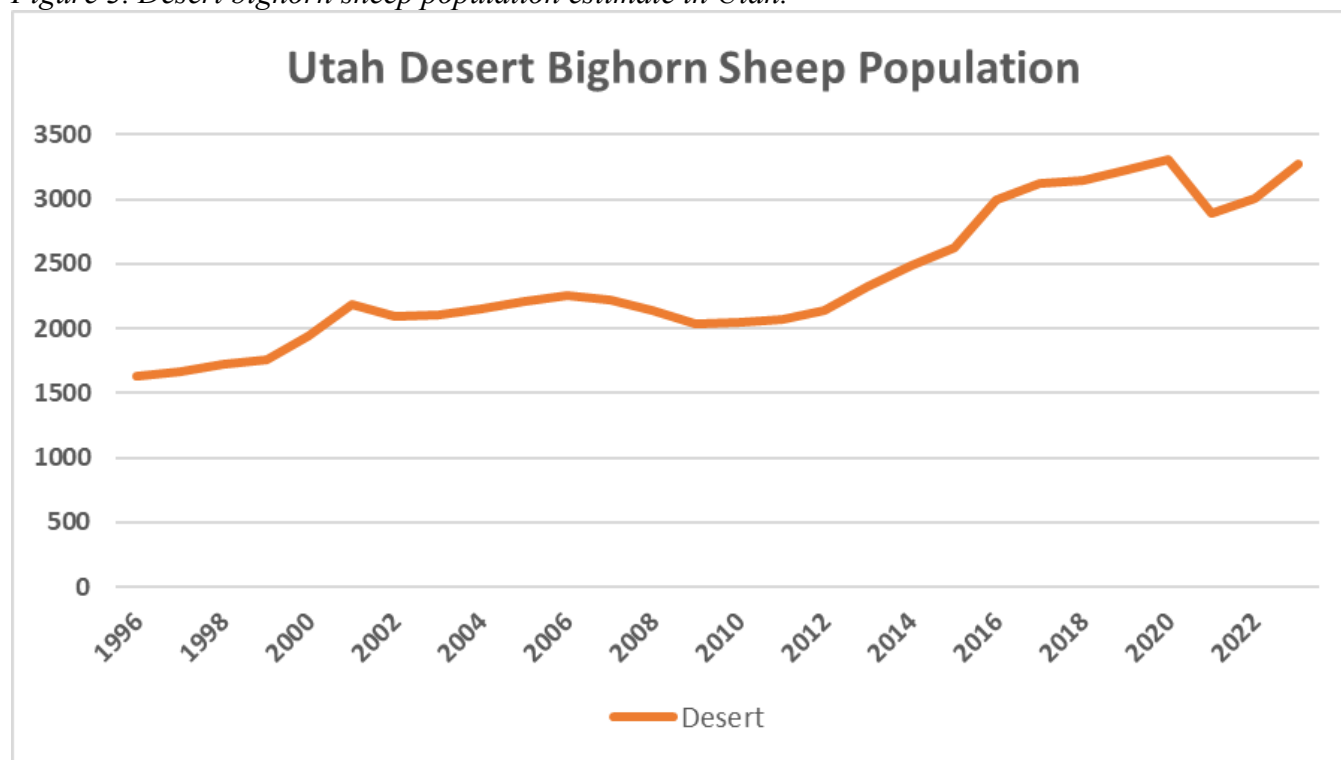
Disease and Herd Health

During the 2023 capture season, 107 DBS were captured and sampled for disease surveillance. In addition, sampling kits were mailed to all permit holders to collect samples from harvested bighorns. No new all-age die-off events were detected, although disease has been identified as a limiting factor on many units throughout the state. In 2023, UDWR collaborated with Utah Department of Agriculture and Food (UDAF) to hire an interagency sheep outreach coordinator tasked with working with landowners and permittees at a statewide level to reduce disease risk in prioritized areas. Multiple potential spillover events have been prevented as a direct result of this position.

Test and Remove

No test and remove efforts have been implemented to date. However, this management tool will be considered in response to any documented disease outbreaks in populations that may be conducive and receptive to a test and remove effort.

*- Rusty Robinson, Once-in-a-lifetime Species Coordinator*

Washington

Rocky Mountain Bighorn Sheep

Population

Washington Department of Fish and Wildlife (*hereafter;* WDFW) manages 17 bighorn sheep herds that occupy a portion of their historic range within the eastern portion of the state. Bighorn sheep were extirpated from Washington by 1935, and these herds are the result of reintroductions, which began in 1957 (Johnson, 1983) and continued until 2004. Herds associated with the eastern foothills of the Cascades and Okanogan Highland are designated as California bighorn (10 herds) while those in the Blue and Selkirk mountains are considered Rocky Mountain bighorns (6 herds). One herd, Tieton, remains under the Department's purview but contracted pneumonia and was depopulated in 2013 to reduce the risk of disease transmission to adjacent herds.

Figure 1. Bighorn sheep population distribution, Washington USA. The Blue Mountains herd area is a metapopulation of several distinct herds.
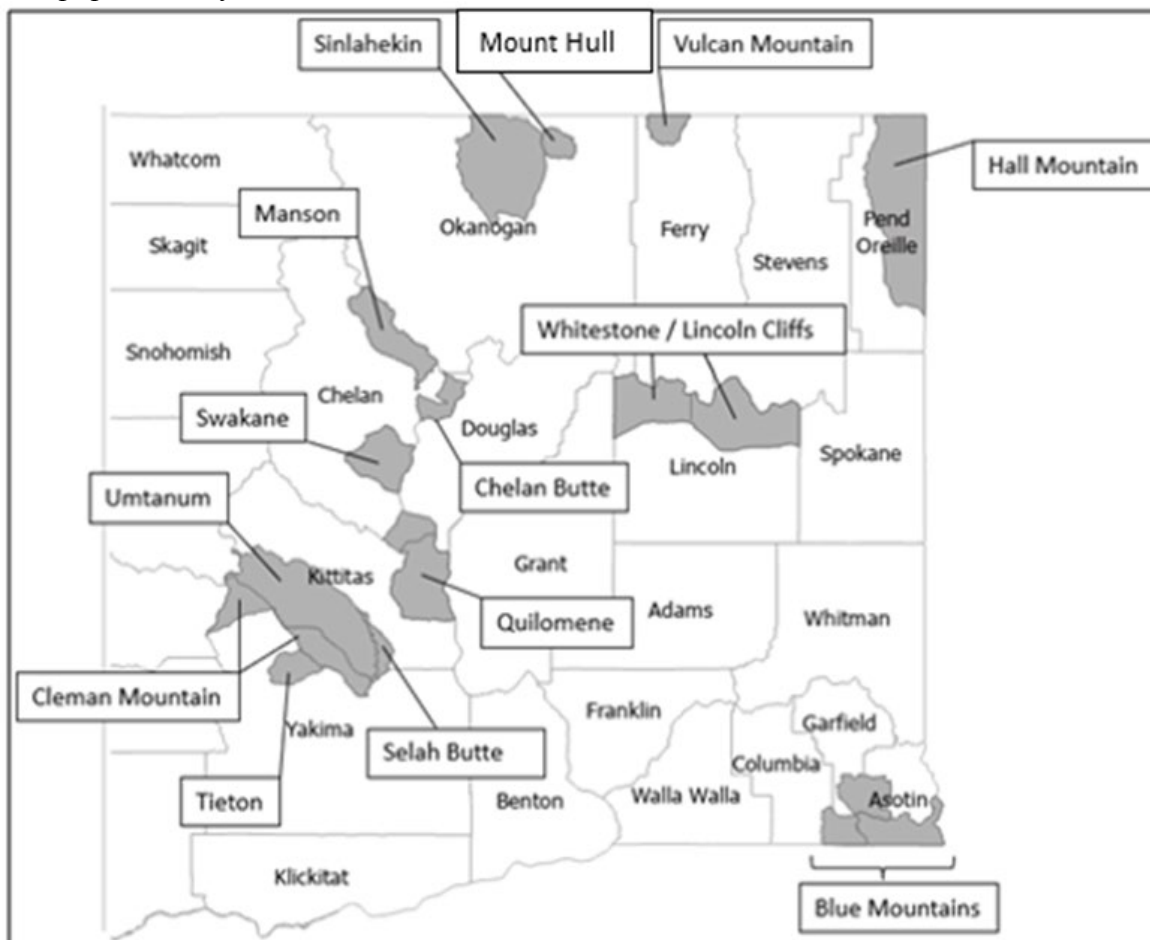

Abundance & Surveys

WDFW uses ground and aerial techniques to survey bighorn sheep to estimate or index abundance and

composition. Surveys typically occur biennially in the fall or early spring and vary in methodology. Despite some herd-specific declines associated with disease, statewide bighorn sheep abundance is increasing (Figure 2). In 2022, a minimum of nearly 1,600 bighorn sheep were distributed throughout the state (Figure 2), slightly less than the statewide objective of 1,750-2,130 defined in our Game Management Plan.

Figure 2. Minimum statewide bighorn sheep population counts with LOESS smoothing derived from aerial and ground surveys, Washington, USA.
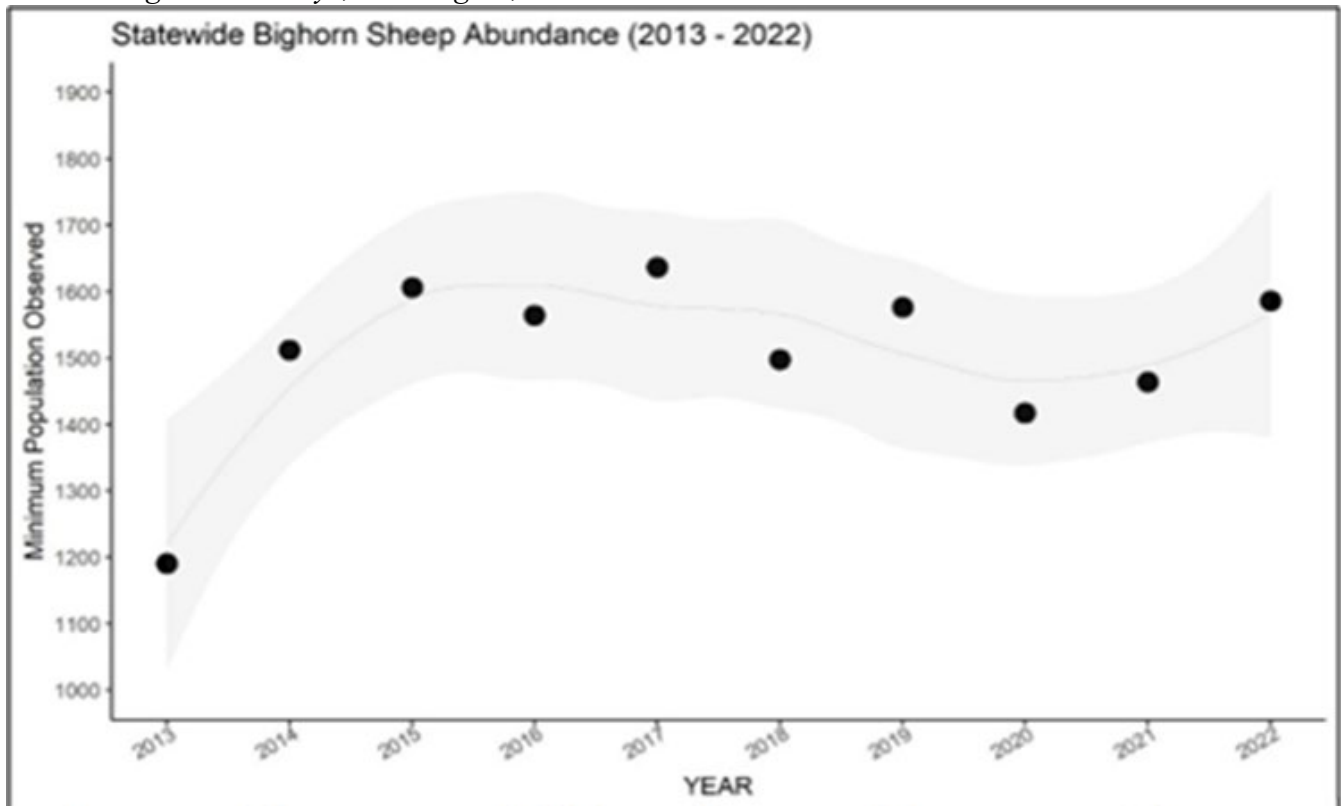

Permits and Harvest

The Department restricts bighorn harvest to limited-entry special permits. These hunts are managed as high-quality opportunities at levels which promote population sustainability, low hunter densities, and high success rates. Adult female and juvenile ram harvest opportunities are offered to manage herd abundance, risk of contact with domestic flocks, or agricultural damage. Permit levels and harvest were lower in 2022 than the preceding three years (Figure 3), when the test-and-remove project in the Yakima Canyon (i.e., Umtanum, and Selah Butte) meta-population was initiated. Population-specific permit levels and harvest are detailed in the State's Status and Trend Report https://wdfw.wa.gov/publications/02474.

Disease

Currently, WDFW has documented *Mycoplasma ovipneumoniae* in seven herds, with the most recent outbreak (i.e., early 2024) in the Blue Mountains herd, along the Idaho border, within the Hells canyon meta-population. WDFW actively participates with Idaho Department of Fish and Game and Oregon Department of Fish and Wildlife on research to optimize test and remove management, and has ongoing projects within the Blue Mountains, Umtanum, Selah Butte, and Cleman Mountains herds (Figure 1). Additionally, WDFW is beginning work with British Columbia, Canada, and Confederated Tribes of the Colville Reservation to better understand, reduce the spread, and hopefully remove psoroptes mange from

the Sinlahekin and Mount Hull herds which are adjacent to populations within Canada and Colville Tribal lands.

Figure 3. Statewide bighorn sheep harvest from 2013-2022. Female harvest is illustrated in light gray (above), and male is illustrated in dark gray.
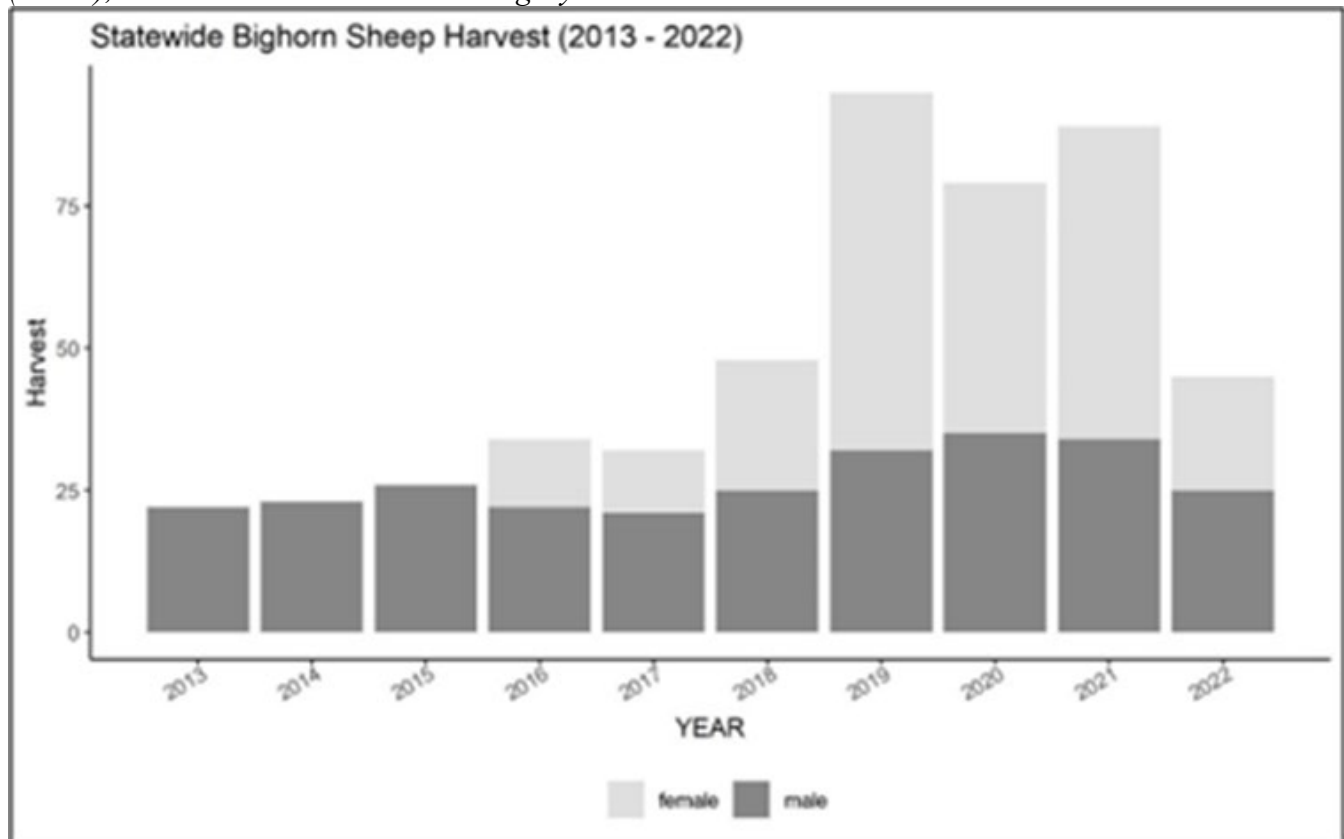
Will Moore, Washington Department of Fish and Wildlife

Wyoming
Population

Rocky Mountain Bighorn sheep populations throughout Wyoming have declined since the early 1990s from an estimated 7,000 sheep in 1990 to a low of 5,800 sheep in 2019. Since 2010 bighorn sheep numbers have generally declined, but showed some recovery in 2019 (Figure 1). At least some of this estimated increase is due to prospering reintroduced herds such as the Ferris/Seminoe population. After the 2021 hunting season it was estimated there were about 6,400 bighorn sheep. License issuance and ram harvest (Figure 1) has similarly declined over the past twenty years. In part, the decline in licenses issued and harvest is linked to several things other than population trend including harvest success, average age of harvested rams, and hunter effort. Because bighorn sheep hunting is so coveted (and now a once-in-a-lifetime opportunity), managers are very conservative with hunting opportunity, but harvest over the past decade has been consistent with change in population size (Figure 2).

Disease and Herd Health

The Devil's Canyon herd in north central Wyoming experienced a pneumonia related die-off between October 2022 and September 2023. Immediately following the end of the 2022 hunting season a significant mortality event impacted the Devils Canyon Herd. The death of a GPS collared ewe in Late

October revealed another 36 sheep carcasses over the course of three days. Fresh carcasses were necropsied and samples sent to the Wyoming Game and Fish Department's Wildlife Health Laboratory. Four living sheep were removed by department personnel after exhibiting clinical signs of pneumonia such as nasal discharge and extreme lethargy (unwillingness to move). Wildlife Health Laboratory staff concluded that this outbreak was triggered by a novel strain of the pathogen *Mannheimia haemolytica*.

Figure 1. Estimated population size and number of rams harvested.
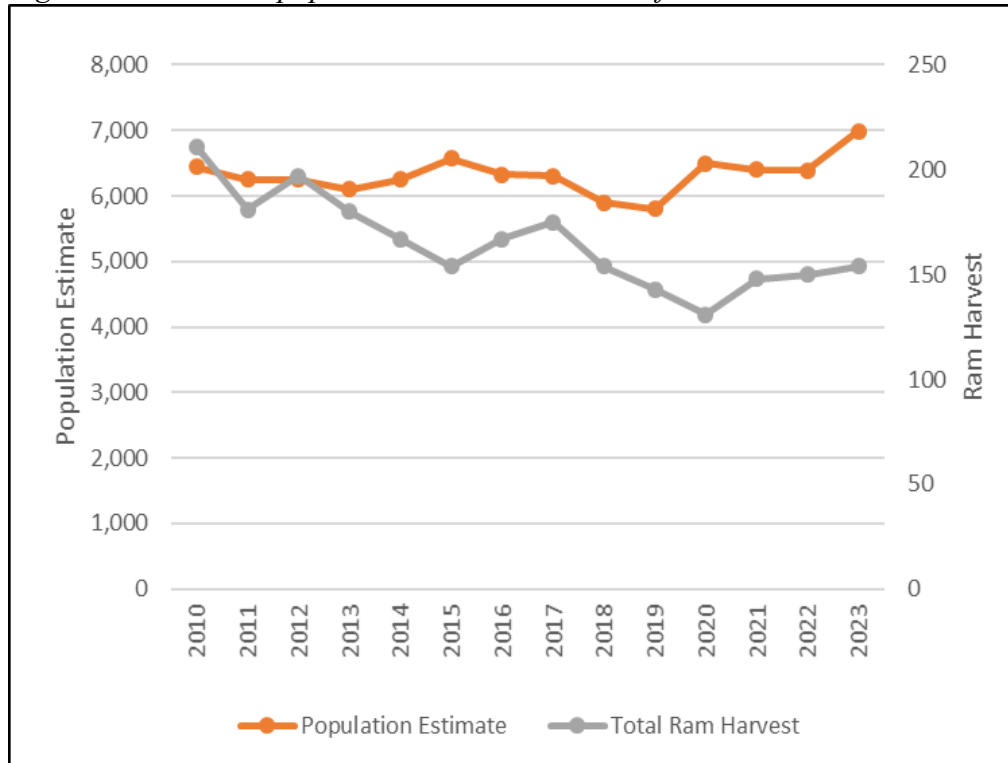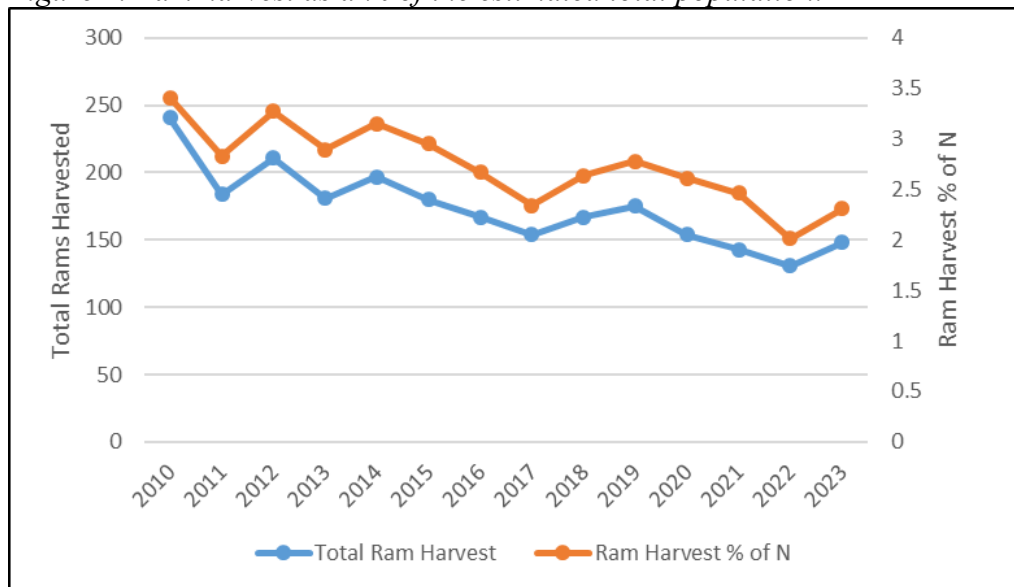

Figure 2. Ram harvest as a % of the estimated total population.

Disease related mortality continued through the fall, 2022 (began with ewes and lambs) and into the winter (final mortalities were rams in November and December). By December 31, 2022: approximately 44%

of the collared sheep (n=6 ewes: 6 rams) were lost to the pneumonia outbreak. Standardized aerial classifications conducted in July 2023 resulted in a total of 142 sheep counted. Shortly after this survey, managers were notified of new mortalities from collared ewes. Between Late July and Early September, 2023 11 of the remaining 13 collared ewes were lost to pneumonia. The pathogen *Mannheimia haemolytica* was again confirmed to be the causal pathogen. Unlike the initial outbreak, the second die-off seemed to disproportionately impact ewes since no lamb or ram mortalities were documented during this period. Although the impact to the entire herd is not yet known, incidental observations were collected in November, December, and January where 30-57 sheep were counted. Currently managers estimate the population in the early spring of 2024 to be 70 individuals. Spring recruitment surveys and summer trend counts will likely reveal the extent of this second episode.

Test and Remove
Given the significant and continual decline in bighorn sheep in the Whiskey Mountain Herd and following over a year's worth of in-depth discussion with other sheep experts, local managers and researchers took a novel approach for Wyoming and implemented "Test and Remove" in the Red Creek sub-herd. The goal was to lower the prevalence of the pneumonia-causing pathogen, *Mycoplasma ovipneumoniae* (M. ovi), by removing "chronic carriers" and ultimately increase overall herd health and lamb survival. It was decided to first test this approach with the smaller Red Rocks portion of the Whiskey herd. Testing for M.ovi has been conducted during captures each December and March since 2015. Based on these testing results, 13 ewes within the Red Rocks sub-herd have been removed (7 in 2022, 4 in 2023, and 2 in 2024). Of the 7 ewes removed between December 2021 and May 2022 during the initiation of this approach, detailed lab necropsies found 6 of 7 (86%) had chronic pneumonia and 4 of 7 (57%) had sinus masses. Of the 4 removed in 2023, 1 (25%) had chronic pneumonia and 2 (50%) had sinus masses. Results from the 2 removed in 2024 were not available as of this writing. Though we have likely lessened the opportunity for mother-to-lamb and then lamb-to-lamb pneumonia transmission to occur, there are other untested ewes within this sub-herd from which transmissions could continue to occur. Lambing season in 2022 was the first glimpse at reproduction/survival after removing 7 of the chronic carriers. During 2022-2023 winter classifications, personnel observed a lamb ratio of 47 lambs per 100 ewes. In 2024, personnel classified 36 lambs:100 ewes. This number of lambs had not been observed in this sub-herd in the past 6 years. In fact, this is more observed lambs than has been seen in the last 6 years combined. We are still in the beginning stages of the project, and are not making inferences about this increased number of lambs, but this is an encouraging step forward.

In 2024, test and remove was expanded to the rest of the Whiskey Mountain herd. In March, 2024 42 ewes were captured and tested. 14 (33%) tested positive using PCR in the field and confirmed in the lab. All 14 have been removed. We are using a "one-strike" protocol to identify chronic carriers. This is a departure from the "two strike" protocol in the Red Creek sub-herd because these sheep are so weary of a helicopter and once they are caught they immediately leave the country and are in the Wilderness. So, getting our hands on the captured sheep to conduct a second test is nearly impossible and would greatly delay or hamper our ability to remove carriers. It is recognized this protocol may increase the likelihood of removing a positive animal that could clear the pathogen. We are not removing any rams or yearling ewes.

Daryl Lutz, Wyoming Game and Fish Department

Yukon
The Yukon has two native subspecies of thinhorn sheep; Dall's and Stone's sheep. There are

approximately 22,500 thinhorn sheep within the territory. Stone's sheep are limited in number, potentially occurring just north of the southern border of the Yukon. The majority of Dall's sheep are located in the southern and southwest region of the Yukon, particularly in the Kluane and Ruby mountain ranges. However, sheep can be found in all mountain ranges, including in the northernmost, Richardson mountain range.

Figure 1: Generalized Yukon thinhorn sheep distribution
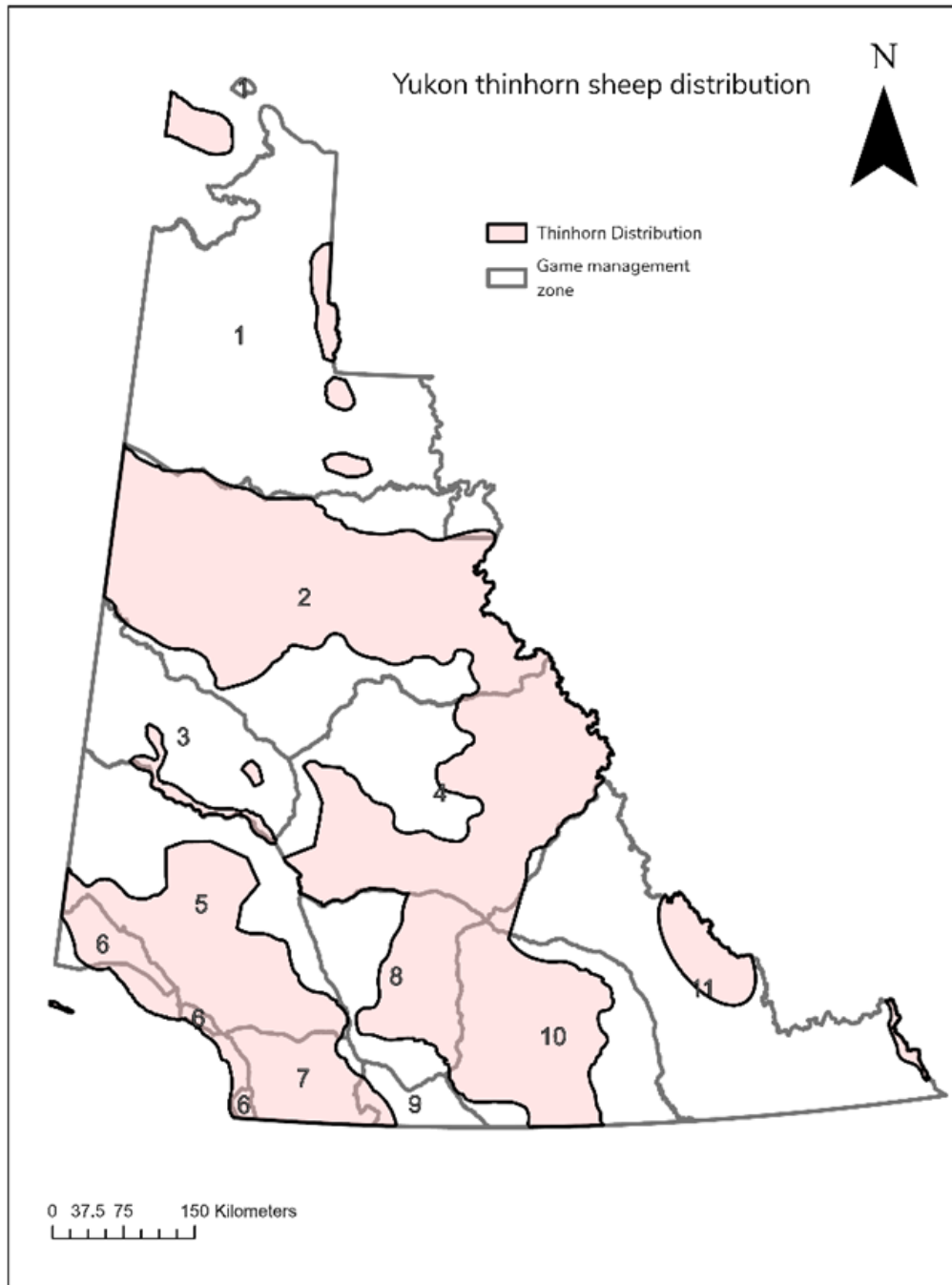

Harvest trends

Licensed hunting is closed for all rams that are less than full curl and under 8 years of age. Annually, licensed hunters are able to harvest one legal ram from an open Game Management Subzone (GMS). In some Game management Zones (GMZ), sheep are managed at the level of the Sheep Management Unit

(SMU), which reflects the mountain ranges most frequently occupied by a herd of sheep and with little emigration or immigration from other adjacent herds. In regions where human access and hunting pressure is likely to be higher, hunters can apply for a permit to hunt sheep in a permit hunt authorized area. For example, several GMSs and SMUs closer to Whitehorse require a hunting permit to legally harvest a ram. Compliance with hunting regulations is monitored by requiring hunters to submit ram skulls for standardized measurements. A unique, numbered plug is placed in one horn and horn material is collected for preservation of genetic information. Ewes and lambs are protected from hunting.

The number of sheep seals obtained by licensed hunters, including resident and non-resident hunters, has steadily increased since 1995 (Figure 2, Milligan, 2018). On average, 252 sheep are harvested annually with 32% harvested by resident hunters and 68% harvested by non-resident hunters (Milligan, 2018). On average, 11% of resident hunters and 55% of non-resident hunters are successful in harvesting a sheep (Milligan, 2018).

Harvest rates are recommended when there is a relatively updated estimate (~5 years) of herd size by a minimum count. In frequently surveyed herds, a harvest rate of no more than 4% of the non-lamb population is recommended.

Figure 2: The number of sheep seals sold to licensed hunters by hunter type.
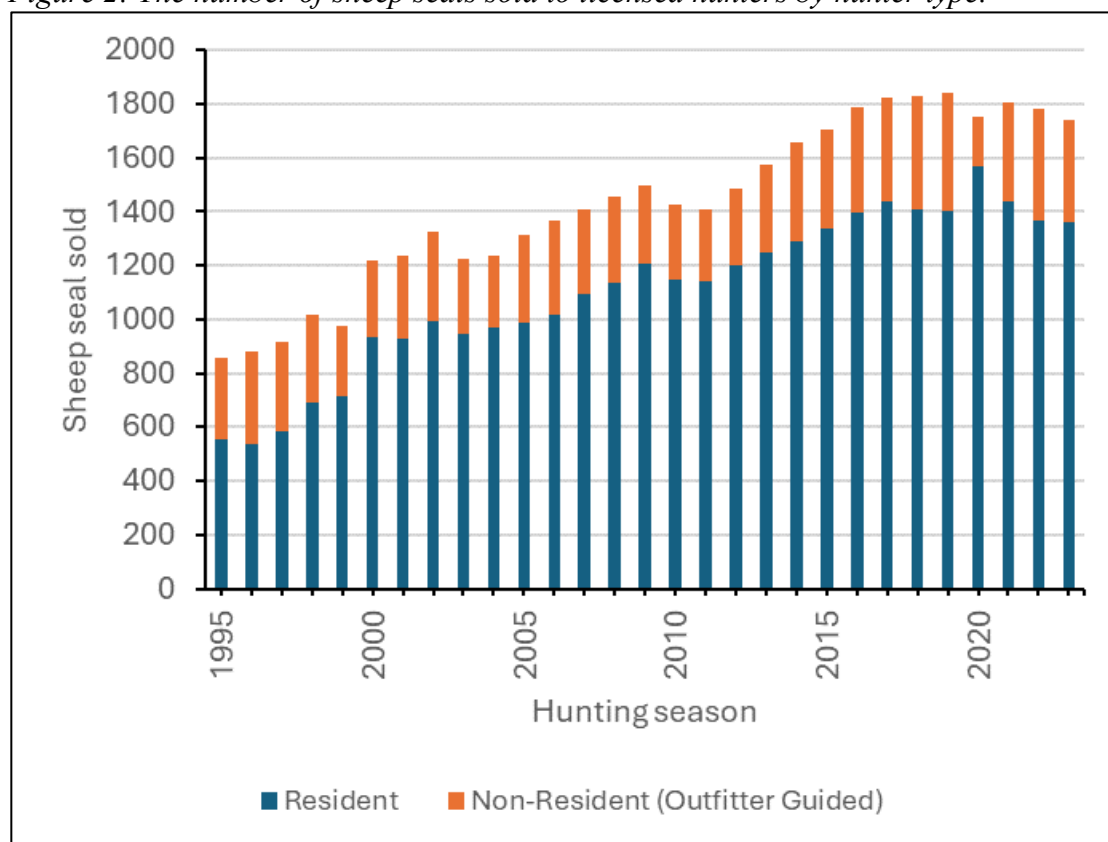
Management
Management of thinhorn sheep within the territory is guided by the published document – Science-based guidelines for management of thinhorn sheep in Yukon (Environment Yukon, 2019). When such units have been established, sheep herds are managed at the level of the Sheep Management Unit and otherwise, at the level of the Game Management Subzone, which represents a discrete mountain block. Management primarily consists of a combination of monitoring populations and harvest management.

Sheep populations in the southern and south-west regions of the Yukon have historically been surveyed more frequently than in other regions. Obtaining population trend information is generally possible in frequently surveyed regions (every 5-10 years) but more challenging in less frequently surveyed areas such as in the central and northern regions of the Yukon. Population surveys are prioritized based on management concerns and the need to update population information. Sheep herds that are easily accessed by roads or trails are likely to experience higher disturbance from human activities and greater harvest pressure. Surveys are used to estimate total minimum counts and not population size or density. Productivity is estimated by obtaining a sex and age class ratio.
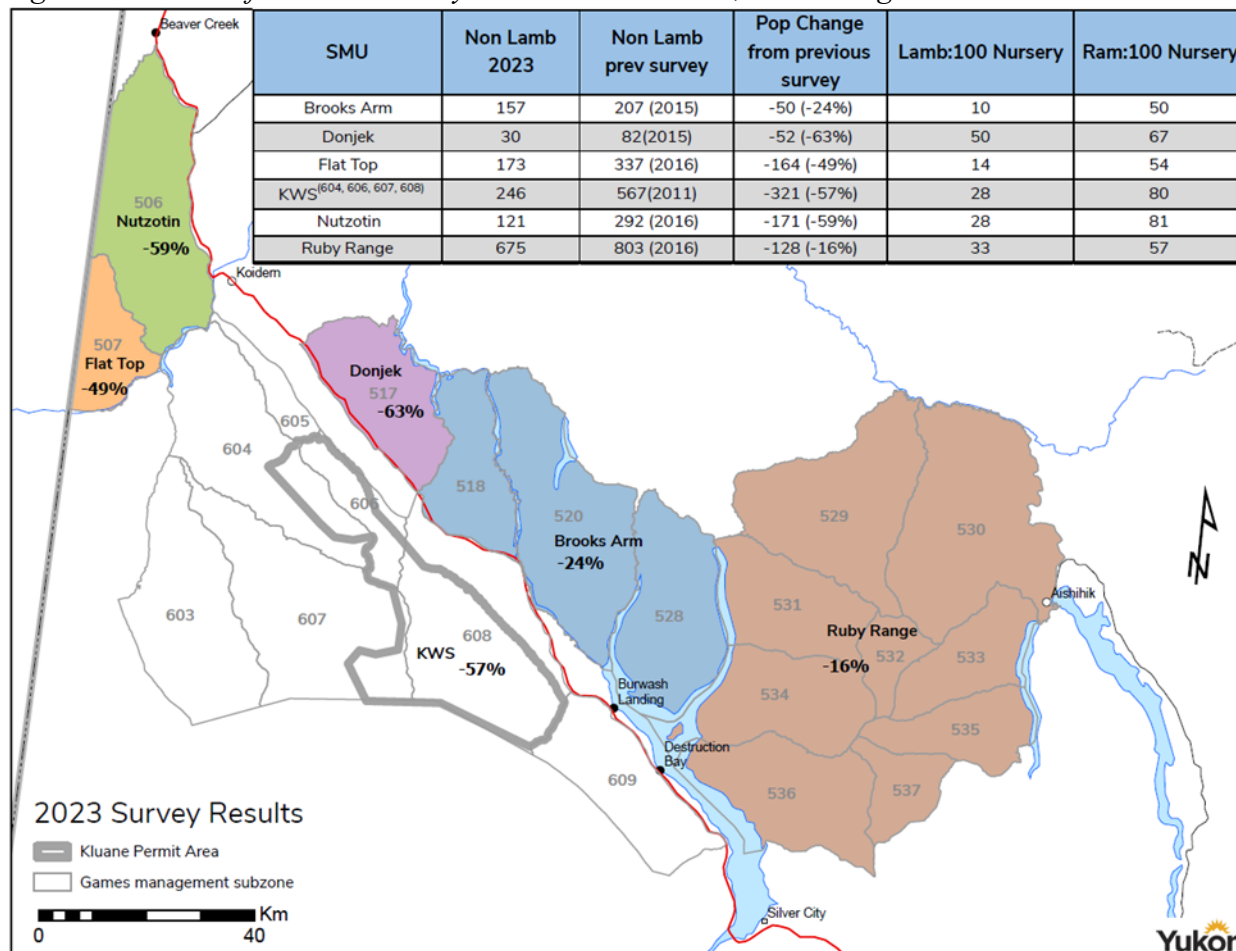
From 2014 and 2016 large-scale surveys of GMZ 7 (Southern Lakes region in proximity to Whitehorse and Carcross) and GMZ 5 (Kluane and Ruby Range region in proximity to Haines Junction) were completed. These two management zones experience relatively high harvest pressure and contain some of the highest densities of sheep in the Yukon. Across all of GMZ 7, 3,112 sheep were observed, 2,490 of which were non-lambs. Compared to surveys conducted in the 1970s, a 22% increase in the non-lamb population was noted and the population was deemed to be stable (Hegel and Russell, 2018). Across all of GMZ 5, 3,766 sheep were observed, 3,011 of which were non-lambs. The only previous comprehensive survey of GMZ 5 occurred in 1974. In 2015, sheep numbers in GMZ 5 were found to be similar to those observed in 1974 and the population was considered to be stable.

In 2022 and 2023, several SMUs in GMZ 5 were surveyed due to concerns that sheep populations may have been adversely affected by consecutive years of late spring melt and higher than average snow accumulation. Results indicated that sheep herds in these SMUs had experienced declines ranging from 16% to 63% (Figure 3). Ruby Range SMU holds the largest population of sheep in GMZ 5 (n = 675 (non-lamb), yr = 2023) and experienced the smallest decline at 24% in 2022 and 16% in 2023. The SMUs with fewer sheep, ranging from 30 sheep to 192 sheep, saw larger declines at above 30%.

Historically, sheep populations within the Yukon have experienced comparable levels of decline (for example, in the early 1990s). Due to the timing of surveys, detection of past declines relies on a combination of observational reporting from First Nations community members, resident hunters and outfitters, and biologists in addition to surveys. Reasons underlying the current decline are likely similar to those of previous declines; challenging environmental conditions, such as deep snowpack, ice, and late springs that impact food sources and adult and lamb survival rates over consecutive years.

The significant population declines in the southwest Yukon are concerning given that the effects of climate change may increase the frequency and severity of challenges that sheep populations may face. Inclement weather events may occur more frequently or less frequently or at unseasonable times. Understanding how sheep populations may be vulnerable to changing conditions will help wildlife managers to continue to support self-sustaining populations.

Figure 3: Results of the 2023 survey in south-west Yukon, Kluane region.

SMU	Non Lamb 2023	Non Lamb prev survey	Pop Change from previous survey	Lamb:100 Nursery	Ram:100 Nursery
Brooks Arm	157	207 (2015)	-50 (-24%)	10	50
Donjek	30	82(2015)	-52 (-63%)	50	67
Flat Top	173	337 (2016)	-164 (-49%)	14	54
KWS (604, 606, 607, 608)	246	567(2011)	-321 (-57%)	28	80
Nutzotin	121	292 (2016)	-171 (-59%)	28	81
Ruby Range	675	803 (2016)	-128 (-16%)	33	57

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Environment Yukon. 2019. Science-based guidelines for management of Thinhorn Sheep in Yukon (MR19-01). Whitehorse, Yukon, Canada.

Meghan Larivee, Fish and Wildlife Branch, Department of Environment, Government of Yukon

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