Appendix B – Desert Bighorn Conservation Unit Plans

In 1986, Assembly Bill 3117 was voted in by the California Legislature. That legislation amended California Fish and Game Code (FGC) Section 4700 et seq. and added Sections 4900 through 4904. The legislature declared bighorn sheep an important wildlife resource in California to be managed and maintained at sound biological levels. It also directed the California Department of Fish and Game (now the California Department of Fish and Wildlife, CDFW) to determine the status and trend of bighorn sheep populations by management units.

The California Fish and Game Code Section 4901 mandates the preparation of management plans for each bighorn sheep management unit. The Department defines Bighorn Conservation Units (BCU) as management units; six BCUs have been identified throughout the State. The California Fish and Game Code specifies that each BCU plan must provide information regarding:

> (1) the numbers, age, sex ratios, and distribution of bighorn sheep within the conservation unit;
> (2) range conditions and a report on the competition that may exist as a result of human, livestock, wild burro, or any other mammal encroachment;
> (3) the need to relocate or reestablish bighorn populations;
> (4) the prevalence of disease and/or parasites within the population; and
> (5) recommendations for achieving the policy objectives of Section 4900 to encourage the preservation, restoration, utilization, and management of California's bighorn sheep population.

Each BCU plan may be updated independently of other BCU plans, and the Conservation and Management Plan for Bighorn Sheep in California (CDFW, 2025), to consider new data, changes in policies, regulations and code, changes in the environment, best available scientific information, or other factors related to bighorn sheep conservation.

Conservation Unit Descriptions:

Unit plans follow the hierarchy of populations as described in Section III of the Conservation and Management Plan for Bighorn Sheep in California.

> **Bighorn Conservation Unit (BCU):** A management area defined by manmade barriers or unique geography. Desert bighorn are divided into five distinct BCUs: Northern Deserts, North Central Deserts, South Central Deserts, Southern Deserts, and Transverse Ranges (Figure 1). There is a sixth BCU for Northern California but as of 2025 there are only transient bighorn populations from neighboring states.
>
> **Subpopulation:** Bighorn sheep that occupy an area contained within a BCU, often including more than one mountain range, connected by regular, annual movements of individuals (typically males).

Deme: A discrete geographic area within a subpopulation utilized by one or more groups of female bighorn.

Each BCU may consist of multiple subpopulations, and each subpopulation may consist of multiple demes.

Figure 1. The six Bighorn Conservation Units (BCUs, dark grey) and current and historical (light grey) bighorn subpopulations within them.

Goals, Objectives, and Actions:

Each BCU plan builds on the goals and objectives framework provided in the Conservation and Management Plan for Bighorn Sheep in California. The action items

are the Department's recommendations for achieving its management goals. These actions apply broadly to every BCU, but within each BCU plan these actions may be tailored to specific management recommendations within the subpopulation and deme level.

Goals, objectives, and actions for the management of desert bighorn – from Conservation and Management Plan for Bighorn Sheep in California.

Goal 1: Manage desert bighorn subpopulations for their long-term persistence in the face of changing environmental conditions.

Table 1. Objective 1.1: Monitor the population size and demographic rates for each desert bighorn subpopulation. Use this information to identify trends of conservation concern and inform management recommendations.

Action	Objective 1.1 Task
Action 1.1.1.	Utilize existing subpopulation data in appropriate models to identify data gaps, prioritize monitoring actions, and calculate sample sizes necessary to achieve objectives.
Action 1.1.2.	Capture and mark desert bighorn to provide marks for various subpopulation survey methods and influence survey design.
Action 1.1.3.	Deploy camera traps and conduct ground surveys, helicopter surveys, and fecal DNA collection efforts to estimate abundance, density, demographic composition, survival, and recruitment rates of subpopulations of desert bighorn.
Action 1.1.4.	Monitor the survival of individuals from Action 1.1.2. and recover mortalities in a timely manner to investigate cause of death.
Action 1.1.5.	Explore alternative monitoring and analytical approaches as new technology is developed, for example the use of fixed-wing, or unmanned, aircraft using photographic and machine leaning identification methods.
Action 1.1.6.	Encourage, support, and collaborate with partner agencies to conduct monitoring of desert bighorn.
Action 1.1.7.	Build and maintain Department capacity and the support necessary to implement and sustain these monitoring efforts.

Table 2. Objective 1.2 Monitor subpopulation health and identify threats from emergent disease, predation, or other factors, which may be mitigated by management action.

Action	Objective 1.2 Task
Action 1.2.1.	Use a combination of survey results, collared animal survival, and direct observations to detect potential outbreaks or die-offs. Sample individuals from capture (1.1.2) and mortality (1.1.4) events and test for pathogen presence, exposure, or disease.
Action 1.2.2.	Explore risk of disease transfer by tracking presence of livestock operations within and adjacent to desert bighorn, particularly those involving domestic sheep or goats, along with data from Objective 1.1.
Action 1.2.3.	Create educational materials highlighting the risks of disease and mitigation actions for the public and distribute them to appropriate locations such as feed stores.
Action 1.2.4.	Develop and outreach agricultural groups and extension offices, livestock veterinary clinics, etc. on conservation of desert bighorn through mitigation of disease risk.
Action 1.2.5.	Minimize risk of contact with domestic sheep or goats, create barriers to transmission and remove stray or feral goats and sheep. If data suggest significant subpopulation decline related to emergent disease or if emergent disease is otherwise suspected, increase monitoring of the subpopulation, monitor surrounding subpopulations for signs of disease and consider removing infected individual bighorn as necessary.
Action 1.2.6.	Work with Department Law Enforcement Division Air Services Unit, Department contractors, DOD, NPS, BLM, CalFire, and California Highway patrol to coordinate emergency assistance, including aerial support, in case of loose domestic sheep or feral goats or emergent disease.
Action 1.2.7.	Monitor and manage desert bighorn subpopulations for outbreaks of non-infectious diseases such as botulism contamination in water sources.
Action 1.2.8.	Monitor non-disease related mortalities (1.1.4) and potential compounding effects on subpopulation health.

Table 3. Objective 1.3 Develop and implement science-based recommendations to maintain, enhance, restore, and monitor connectivity and genetic diversity while considering the risks of disease transmission.

Action	Objective 1.3 Task
Action 1.3.1.	Collaborate with partners to collect and analyze genetic information through tissue, blood, and fecal samples to monitor genetic diversity and connectivity between subpopulations, BCUs, and potentially states.
Action 1.3.2.	Analyze GPS, telemetry, genetic, disease, and observational data to monitor connectivity between subpopulations, BCUs, and states.
Action 1.3.3.	Maintain and increase connectivity and gene flow among subpopulations by managing water, mitigating, and preventing barriers such as fences or development, and limiting further fragmentation.
Action 1.3.4.	Create and maintain one or more wildlife overpasses across major highways and between each BCU.
Action 1.3.5.	Monitor vacant and transient habitat for occupancy and recolonization.
Action 1.3.6.	If supported by careful examination of risks and benefits, conduct translocations to augment or reintroduce populations of desert bighorn to promote stable occupancy of suitable habitats.

Table 4. Objective 1.4 Explore alternative monitoring strategies to reduce direct and external costs, including greenhouse gas emissions, risk to personnel, and stress or injury to desert bighorn.

Action	Objective 1.4 Task
Action 1.4.1.	Use available alternatives that generate comparable or better data to helicopters where feasible for captures and surveys.
Action 1.4.2.	Utilize new technologies such as drone surveys and machine learning for trail camera-based mark-resight as they become available and are validated.

Table 5. Objective 1.5 Develop and update Bighorn Conservation Unit (BCU) plans to incorporate new information and guide the management, conservation, possible reintroduction, and long-term persistence of desert bighorn populations.

Action	Objective 1.5 Task
Action 1.5.1.	Develop BCU plans.
Action 1.5.2.	Review and revise BCU plans at least every 10 years.

Goal 2: Conserve, restore, and manage habitat and water availability to support sustainable desert bighorn subpopulations.

Table 6. Objective 2.1 Increase the Department's capacity to monitor and manage bighorn sheep habitat.

Action	Objective 2.1 Task
Action 2.1.1.	Develop a dedicated crew to monitor and manage desert bighorn habitat, including a permanent project lead and multiple technicians.
Action 2.1.2.	Continue to work with NGOs and partner agencies to monitor and manage desert bighorn habitat.

Table 7. Objective 2.2 Ensure adequate distribution of surface water through protection of existing natural sources and maintenance, expansion, and improvement of existing, or construction of new wildlife water developments where appropriate.

Action	Objective 2.2 Task
Action 2.2.1.	Conduct surveys and compile hydrological data on desert water sources to map water availability and suitable habitat for desert bighorn both currently and under future climate change scenarios.
Action 2.2.2.	Encourage the development of numerical groundwater models for groundwater basins where water sources are observed to be in decline, or where proposed surface or groundwater management actions may impact water availability.
Action 2.2.3.	Use GPS collar and camera survey data to determine desert bighorn usage of water sources and identify critical sites.
Action 2.2.4.	Regularly monitor water sources to identify changes in water level signaling potential scarcity issues or maintenance needs, and to facilitate planning for water augmentation when warranted. Enhance remote monitoring capabilities via installation of satellite sensor systems where needed to ensure up-to-date data.
Action 2.2.5.	Maintain existing WWDs in functional condition, including repairs and water hauls as necessary. Work with land management agencies and NGOs to coordinate these actions.
Action 2.2.6.	Protect and maintain wildlife access to natural surface water by removing invasive or excessive vegetation, maintaining minor developments, and limiting surface water diversions or groundwater extraction that may impact water availability in some groundwater basins.
Action 2.2.7.	Evaluate non-functional or unused WWDs for possible redesign, relocation, or removal according to assessed habitat needs.
Action 2.2.8.	Install new WWDs where necessary to replace outdated systems, supplement loss of natural water sources, expand summer habitat, or increase connectivity.

Table 8. Objective 2.3 Implement long-term monitoring of nutritional quality of desert bighorn habitats by measuring body condition of desert bighorn and/or by quantifying forage using remotely sensed imagery or ground sampling.

Action	Objective 2.3 Task
Action 2.3.1.	Measure body condition of desert bighorn during captures.
Action 2.3.2.	Measure forage quality and availability via remote sensing, ground surveys, and direct sampling of bighorn fecal pellets and plants used by bighorn.
Action 2.3.3.	Evaluate changes in diet composition relative to environmental change.

Table 9. Objective 2.4 Collaborate with Tribes, land management agencies, and private entities to evaluate and eliminate or minimize the impacts of competition from non-native ungulates.

Action	Objective 2.4 Task
Action 2.4.1.	Coordinate with land management agencies to track the presence and abundance of domestic livestock and burros.
Action 2.4.2.	Encourage the retirement of grazing allotments and exclusion of cattle from key water sources where ranchers and land managers agree.
Action 2.4.3.	Encourage the removal of burros and their exclusion from desert bighorn water sources wherever possible.

Table 10. Objective 2.5. Work with Tribes and land management agencies to identify and minimize negative impacts on desert bighorn subpopulations due to human activities, fire, or other local threats to desert bighorn habitat. Evaluate and provide feedback on proposed transportation, energy, ground water pumping, or other developments to minimize disturbance to bighorn and avoid impacts to habitat and connectivity.

Action	Objective 2.5 Task
Action 2.5.1.	Monitor the overlap between human activities, fire, and local bighorn habitat threats for any changes in desert bighorn behavior, movements, or population metrics.
Action 2.5.2.	Collaborate with land managers to identify areas where desert bighorn subpopulations and habitat are most at risk from human activities, large-scale developments, and habitat threats.
Action 2.5.3.	Evaluate and provide feedback on proposed transportation, energy, ground water pumping, or other developments to minimize disturbance to bighorn and avoid impacts to habitat and connectivity.
Action 2.5.4.	Coordinate with land managers, regulatory agencies, and utilize the Department's legal authorities to ensure the protection of desert bighorn water sources and the underlying aquifers.
Action 2.5.5.	Work with land management agencies and landowners to prevent or mitigate habitat loss wherever possible.

Goal 3: Provide opportunities for recreational, traditional-cultural, aesthetic, educational, and ecological benefit of desert bighorn.

Table 11. Objective 3.1 Provide opportunities for consumptive use of desert bighorn through hunting quota recommendations consistent with sustainable subpopulation objectives.

Action	Objective 3.1 Task
Action 3.1.1.	Use findings from population surveys as outlined in Goal 1 to provide recommendations for tag quotas annually.
Action 3.1.2.	Use findings from population surveys and disease monitoring to close hunt zones if necessary.
Action 3.1.3.	Use findings from population surveys as outlined in Goal 1 to provide recommendations for new hunt zones.
Action 3.1.4.	Conduct an annual hunter orientation.
Action 3.1.5.	Conduct check-outs of harvested rams. Summarize and report hunter success rates, harvested ram age, and morphometric data.

Table 12. Objective 3.2 Establish cooperative projects to create educational and interpretive materials that enhance opportunities for public viewing and learning about desert bighorn.

Action	Objective 3.2 Task
Action 3.2.1.	Contact interpretive staff at partner agencies and express willingness to assist in developing educational materials for the public.
Action 3.2.2.	Coordinate with the Department's education and outreach team to provide website or social media-based educational content and classroom and field activities for schools and the public where opportunities arise.
Action 3.2.3.	Work with NGOs to provide volunteers with opportunities to assist in monitoring and management of desert bighorn.
Action 3.2.4.	Contribute quarterly updates on the Desert Bighorn Program to the California Wild Sheep Foundation Newsletter.

Table 13. Objective 3.3 Facilitate research on desert bighorn interspecific interactions and ecosystem-level effects that could inform management.

Action	Objective 3.3 Task
Action 3.3.1.	Collaborate with other Department programs working within the range of desert bighorn.
Action 3.3.2.	Identify and collaborate with biogeochemistry and zoo geochemistry researchers.
Action 3.3.3.	Evaluate the effects of WWDs and other habitat improvement projects on other species.
Action 3.3.4.	Maintain an ecosystem-level perspective in desert bighorn research and management.

Goal 4: Develop, enhance, and maintain communication and collaboration with Tribes, stakeholders, agencies, and researchers regarding desert bighorn conservation and management.

Table 14. Objective 4.1 Collaborate with Tribes, public agencies, and stakeholders to facilitate management actions on public land for the conservation of desert bighorn.

Action	Objective 4.1 Task
Action 4.1.1.	Contact Tribes to establish cooperation on habitat management and conservation. Expand dialogue with Tribes to better incorporate traditional knowledge into management practices.
Action 4.1.2.	Explore opportunities to allocate a portion of hunting tags to citizens of California Tribes.
Action 4.1.3.	Develop and sustain opportunities to provide culturally significant parts of harvested desert bighorn (e.g., hooves) to California Tribes.
Action 4.1.4.	Work with each NPS unit to support or collaborate on management and monitoring activities.
Action 4.1.5.	Meet annually with BLM to inform on management and monitoring activities within each district.
Action 4.1.6.	Complete BLM California Desert District water monitoring and maintenance Environmental Assessment.

Table 15. Objective 4.2 Cultivate and maintain relationships between Department staff, Tribes, NGOs, and stakeholders.

Action	Objective 4.2 Task
Action 4.2.1	Develop open and effective communication and reporting channels between the Department, Tribes, and NGOs including the Society for the Conservation of Bighorn Sheep (SCBS), the California Chapter of the Wild Sheep Foundation (CAWSF), and Desert Wildlife Unlimited (DWU).
Action 4.2.2	Attend biannual Sheep Summit meetings with partners.
Action 4.2.3	Provide Department personnel to assist with and be present for NGO projects when needed.

Table 16. Objective 4.3 Pursue opportunities for collaborative research with academic institutions, Tribes, state and federal agencies, and stakeholders to address conservation issues and develop scientifically rigorous management actions.

Action	Objective 4.3 Task
Action 4.3.1.	Continue collaborative research with academic partners on bighorn genetics and connectivity, microbiome and nutritional analysis, and any future research projects.
Action 4.3.2.	Pursue and support collaborative research opportunities with Tribes.
Action 4.3.3.	Maintain regular communication with state and federal agencies in neighboring states and collaborate on desert bighorn research and management, as needed.
Action 4.3.4.	Identify gaps in knowledge and facilitate future research opportunities with partners.
Action 4.3.5.	Participate in the research and publishing of peer-reviewed journal articles.
Action 4.3.6.	Attend relevant professional meetings and conferences (especially WAFWA WSWGI & WHC and DBC) to showcase program efforts, facilitate collaboration with relevant partners, and gain exposure to contemporary management techniques.
Action 4.3.7.	Develop data-sharing policies that facilitate collaboration with partners and maintains the public’s best interest.

Table 17. Objective 4.4 Periodically report to the public on the status of desert bighorn in California and the program's management activities.

Action	Objective 4.4 Task
Action 4.4.1.	Publish regular reports on findings and accomplishments from Goals 1, 2 and 3.

Appendix.B1:

The North Central Deserts
Bighorn Conservation Unit Plan

California Department of Fish and Wildlife
West Sacramento, CA

January 15, 2026

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Scott Gardner, Wildlife Branch Chief

1/15/2026

Date

* This plan was prepared in compliance with Section 4901 of the California Fish and Game Code. This plan may be updated as new data becomes available and/or new management priorities arise.

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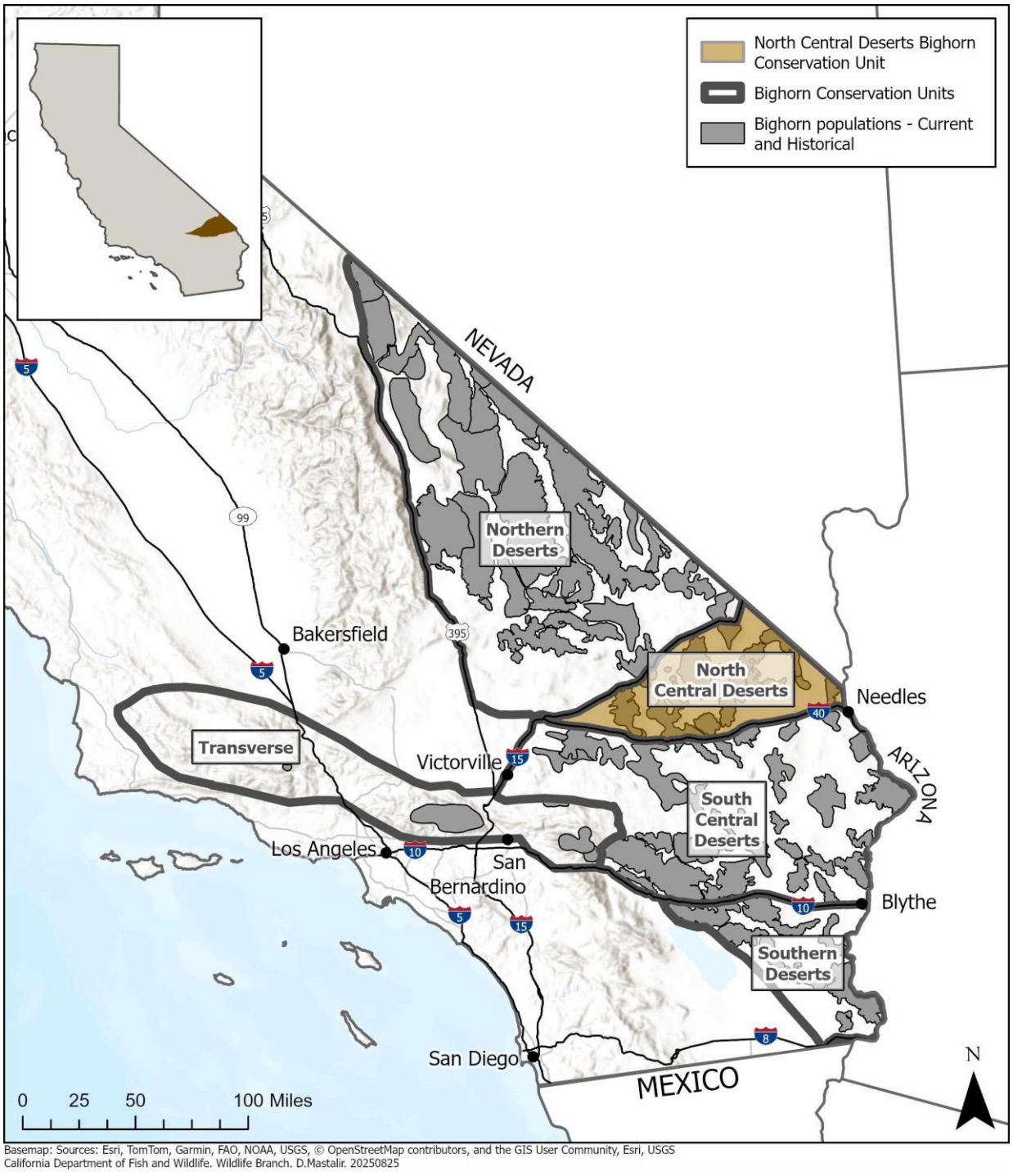

Figure 2. The North Central Deserts Bighorn Conservation Unit (highlighted) is located between Interstates 15 and 40 and along the Nevada border.

1. Purpose

This North Central Deserts Bighorn Conservation Unit (NCDBCU) plan addresses conservation challenges and management actions specific to subpopulations of desert

bighorn sheep (*Ovis canadensis nelsoni*) within the NCDBCU and identifies specific actions and tasks to achieve the goals and objectives outlined in the *Conservation and Management Plan for Bighorn Sheep in California*. The vision of this plan is to have six or more healthy, functioning subpopulations in the NCDBCU that are connected within the larger Mojave Desert metapopulation. This plan is intended to supersede existing herd management unit plans—Old Dad, Kelso, and Marl (CDFG, 1987); Cady (CDFG, 2010)—within the geographic boundaries of the NCDBCU. Although management recommendations are presented for each section, the successful execution of these priority actions will depend on funding and staffing availability.

2. Bighorn Conservation Unit Description

The NCDBCU is bound north by Interstate Highway 15 (I-15) and south by Interstate Highway 40 (I-40), extending east to the Nevada state line (Figure 2). Demographically, the eastern end of this unit extends into Nevada through connectivity with native populations of desert bighorn south of Las Vegas. Lands within the NCDBCU are administered by multiple agencies including the Bureau of Land Management (BLM), the National Park Service (NPS) specifically the Mojave National Preserve (MOJA), the United States Marine Corps, and the California State Lands Commission (Figure 3). These public lands are managed for a variety of public uses including camping, hiking, hunting, shooting sports, off-highway vehicle use, and rockhounding. As well as various types of resource extraction such as grazing, timber harvest, and mining.

Desert bighorn are distributed across island-like mountain ranges within this BCU with movement between adjacent ranges occurring through intermountain habitat. As of 2024, the NCDBCU contains a population of roughly 900 desert bighorn spread over approximately 2,000 square miles of habitat, almost entirely on public land. While many are located outside of areas of regular human visitation, desert bighorn in the Afton Canyon, South Soda, and Providence demes are regularly enjoyed by visitors to those areas. This provides an opportunity to work with partner agencies and inform the public on how to spot, observe, and enjoy desert bighorn without disturbing them.

Water availability is highly limited in the NCDBCU and is one of the biggest factors controlling desert bighorn population size, health, habitat use, and connectivity. Several demes within the NCDBCU rely heavily if not entirely on wildlife water developments (WWDs).

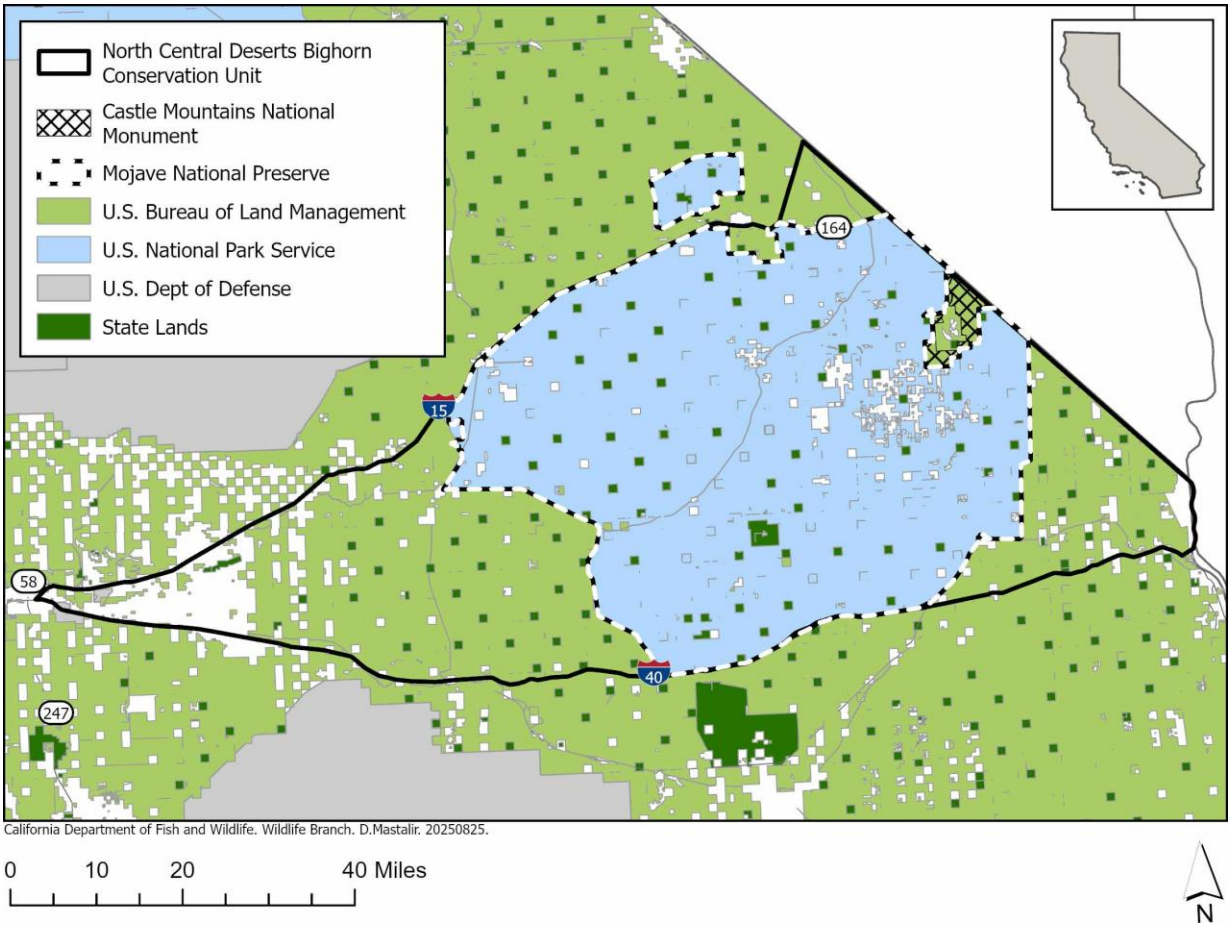

Figure 3. The North Central Deserts BCU consists primarily of federal land managed by the Bureau of Land Management and the National Park Service, specifically the Mojave National Preserve.

Traditionally, the names of mountain ranges have been used to refer to different “populations” of desert bighorn within the NCDBCU. However, since 2013 there has been a significant increase in geospatial data, specifically GPS data, leading to a better understanding of home ranges and connectivity between mountain ranges. Improved geospatial data illuminated high levels of connectivity for some mountain ranges for both rams and ewes (deme), while other mountain ranges are primarily connected by ram movement (subpopulation). The NCDBCU consists of eight subpopulations and thirteen recognized demes (Figure 4).

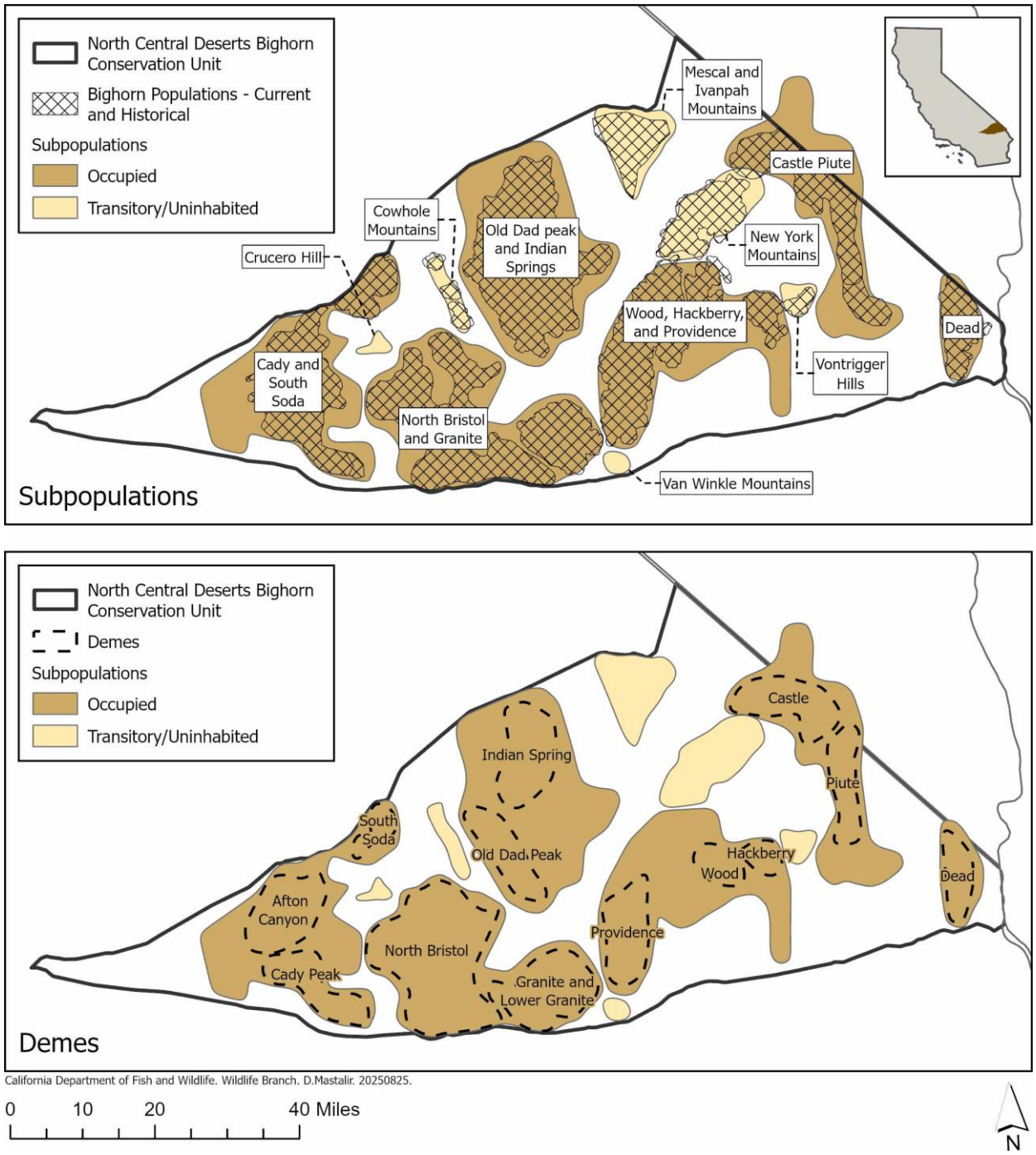

Figure 4. Map of desert bighorn subpopulations and demes in the North Central Deserts BCU. These subpopulations and demes were delineated based on GPS collar data collected from 335 bighorn sheep collared between 2013-2024.

3. North Central Desert Subpopulations

The remainder of this document is divided into six subpopulation sections—Cady and South Soda; Old Dad Peak and Indian Spring; North Bristol and Granite; Woods, Hackberry, and Providence; Castle Piute; and Dead. In addition, there are two sections

covering the transitory/uninhabited areas of the Mescal-Ivanpah Mountains and the New York Mountains. These areas do not currently host bighorn sheep populations but may serve as an area for future translocation or transient habitat, respectively. Movement between subpopulations is uncommon but has been documented by animals with GPS collars on multiple occasions since 2013 (Figure 5, Prentice et al. 2018, Dekelaita et al. 2023, Aiello et al. 2024). While the interstates pose as major barriers to connectivity between BCUs (Epps et al. 2005), recent GPS and genetic data suggest that some movement does occur. Specifically, in 2015, there was a single documented movement between the NCDBCU and the Northern Deserts BCU when an ewe and her lamb crossed from the South Soda Mountains to the North Soda Mountains and then back over I-15 (Dekelaita et al. 2023, Aiello et al. 2023). Similarly, there have been several documented movements of animals between the NCDBCU and the South-Central Deserts BCU, namely between the Granite and Marble Mountains (Epps et al. 2018, Dekelaita et al. 2023, Aiello et al. 2024).

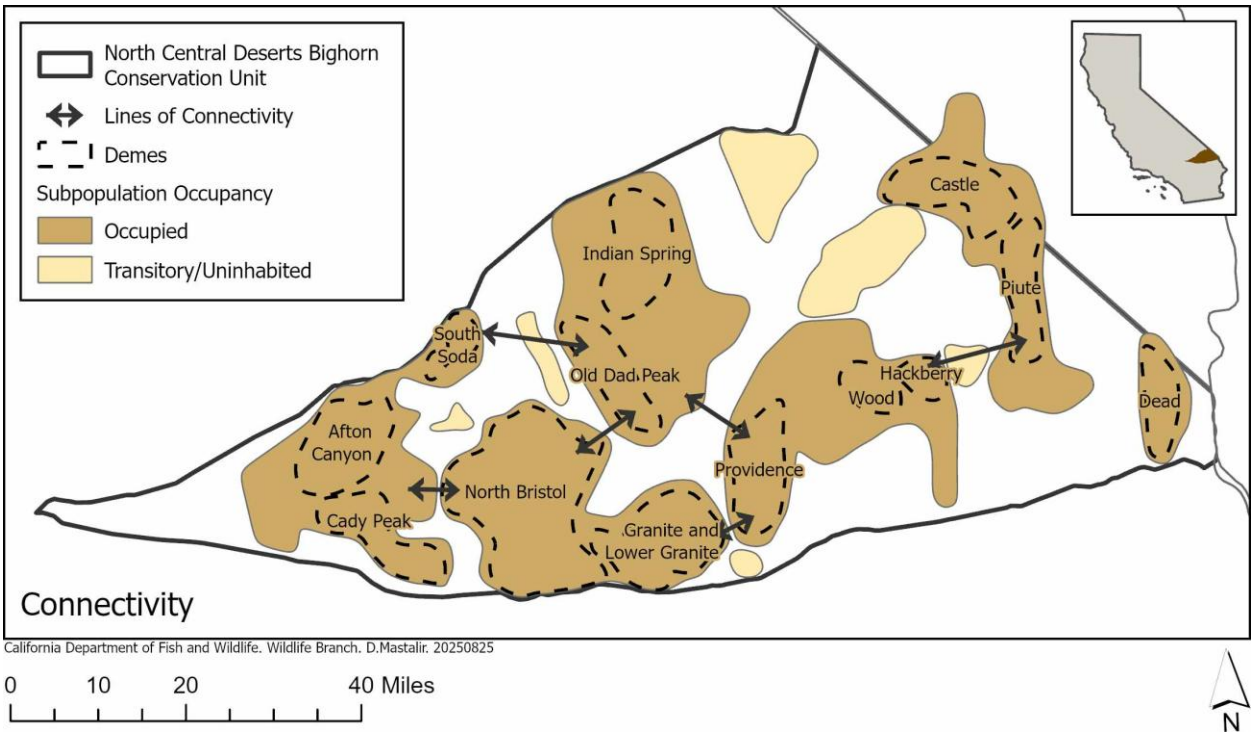

Figure 5. Documented connectivity between desert bighorn (subpopulations / demes) within the North Central Deserts BCU.

In addition to the connectivity publications referenced above, other recent publications involving these subpopulations include an overview of the history of respiratory disease, specifically *Mycoplasma ovipneumoniae* (Shirkey et al. 2021), California translocation history (Bleich et al. 2021), and localized differences in water use (Glass et al. 2022). Within this document, each subpopulation section provides specific information on location, conservation concerns, habitat condition, demographics, mortality factors, translocation history, and public use. Subpopulation-specific actions and management recommendations are listed at the end of each of these topics.

Cady and South Soda Mountains Subpopulation

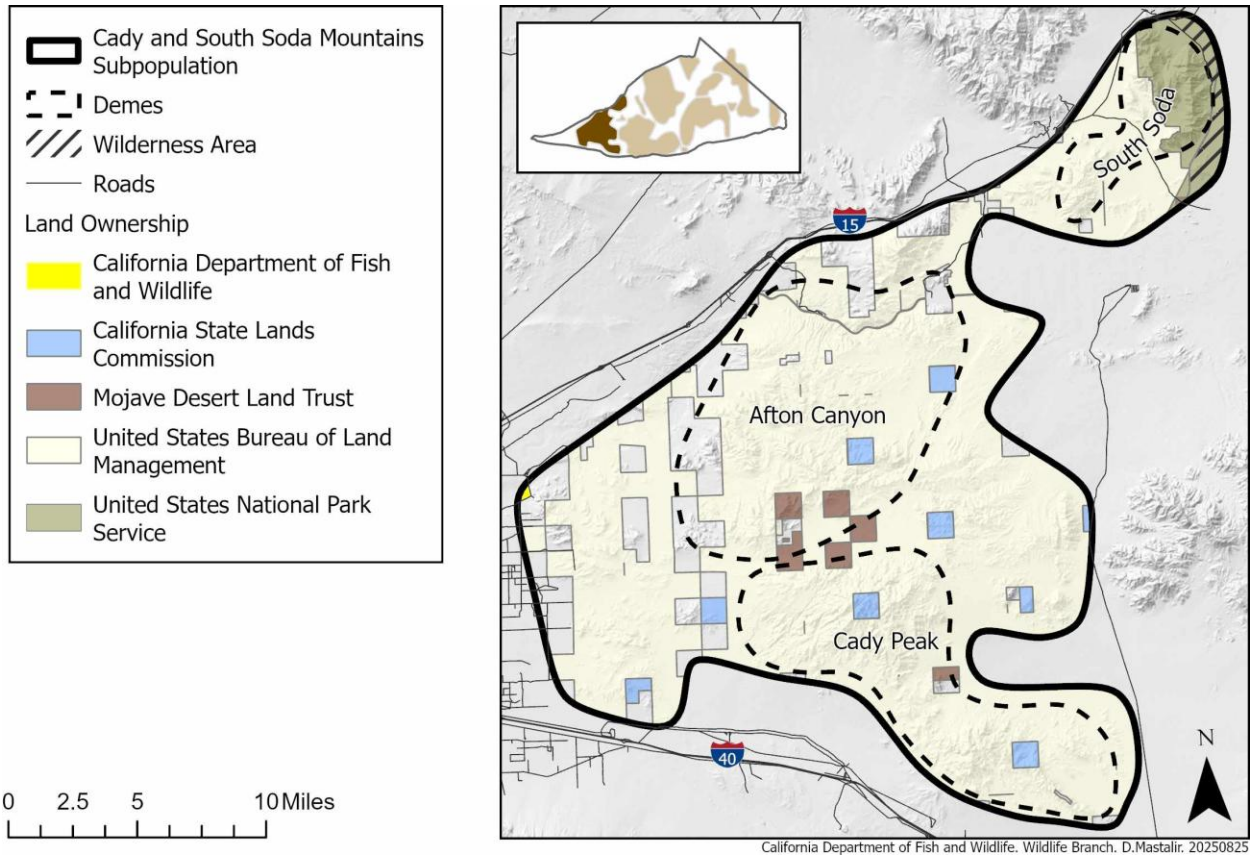

Figure 6. Map of Cady and South Soda subpopulation and the three demes: South Soda, Afton Canyon, and Cady Peak.

The Cady and South Soda subpopulation is located at the western tip of the NCDBCU and bound between I-15 and I-40 to the north and south, respectively (Figure 6). Within the NCDBCU, the Cady subpopulations are strongly connected with the North Bristol and Old Dad subpopulations to the east. Connectivity between BCUs is limited by the interstate highways although both ewes and rams have been documented to successfully and unsuccessfully cross I-15 into the transitorily populated North Soda Mountains (Dekelaita et al. 2023, Aiello et al. 2023).

Key Conservation Concerns:

- There is extensive off-highway vehicle (OHV) use in and around Afton canyon and Razor Road. While desert bighorn in Afton Canyon appear habituated to current levels of use of legal routes, an increase in use or development of illegal routes could disturb desert bighorn, especially during lambing and when accessing water in the summer.
- Trains in Afton Canyon have caused several bighorn mortalities over the years, but not to an extent that threatens the population. The Department requests that

any major railway repairs or construction projects take place outside of summer months when bighorn rely on water there.

- A high-speed rail is planned along I-15, which would cut off any bighorn connectivity from the Soda or Cady Mountains to the north. To mitigate this loss, wildlife overcrossings have been planned north of Zzyzx and Cave Mountain.
- A solar energy development has been planned in the Razor Road area. The Department has proposed that all development should take place at least one-quarter mile from the base of the mountains to minimize impacts to bighorn habitat.

Habitat Conditions:

The ranges encompass roughly 175 square miles spanning elevations between 940 ft at the Soda Dry-Lake and 4,627 ft at Cady Peak. Vegetation communities consist largely of creosote bush (*Larrea tridentata*) with some succulent scrub near Cady Peak. Water is limited in this range, but naturally available where the Mojave River surfaces in Afton Canyon, at a large tinaja (rock basin) near Afton Canyon, as well as at Soda Springs in the California State University (CSU) Desert Studies Center area. Additionally, the Aurora, Cady Peak, Big Gee, and Razor Ranch WWDs provide water sources for desert bighorn and other wildlife.

Cattle grazing was eliminated from the Cady Mountains in 2005, and the last documented presence of feral donkeys or horses was in 1986. Upstream groundwater pumping, diversion of river water, and extensive tamarisk (*Tamarix sp.*) growth has significantly decreased surface water flow in Afton Canyon. The Cady Peak WWD was upgraded in 2017 to increase storage capacity and catchment efficiency. In 2021, the Razor Ranch WWD was constructed on private property in the southwestern Soda Mountains. In 2024, the Aurora WWD was built in the southeast corner of the Cady Mountains. As of 2025, the Big Gee WWD is identified as a high priority for complete system replacement to increase storage capacity and improve catchment efficiency upgrades. In 2026, the construction of a redundant system near Big Gee WWD on state lands is planned. Monitoring these water sources includes visits in the spring and fall to assess water levels and needs for repairs. Remote water monitoring systems are installed on many of the WWDs to aid in tracking water levels.

Management Recommendations:

- Provide comments and analysis on proposed renewable energy projects detailing impacts on desert bighorn habitat and connectivity (Action 1.3.3).
- Collaborate with Caltrans to plan, design, construct, and maintain a minimum of two wildlife overcrossings from Cave Mountain and the South Soda Mountains north to the North Soda Mountains (Action 1.3.4.).
- Monitor the habitat use and distribution of desert bighorn before, during, and after the construction of the two wildlife overcrossings (Actions 1.1.2., 1.3.1., 1.3.2., 1.3.5.).

- Monitor, maintain, and ensure consistent water availability of the critical Cady Peak WWD (Actions 2.2.4. and 2.2.5.).
- Monitor, maintain, and ensure consistent water availability of the Big Gee WWD (Actions 2.2.4. and 2.2.5.). Modernize Big Gee WWD.
- Monitor, maintain, and fill when needed, the new Aurora WWD (Actions 2.2.4., 2.2.5.). Monitor bighorn use of this WWD and changes to use of adjacent habitat and dynamics in the Cady Peak Deme (Actions 1.3.2. and 1.3.3.).
- Collaborate with the (private) property owner at Razor Ranch on the maintenance and filling of the privately owned WWD there (Actions 2.2.4. and 2.2.5.).
- Monitor the critical Mojave River in Afton Canyon for presence of accessible surface water especially during periods of drought (Actions 2.2.1.-2.2.3.). The removal of vegetation, especially invasive tamarisk, may help reduce the loss of surface water (Action 2.2.6).
- Monitor the Afton Canyon Tinaja for continued bighorn use and signs of changes to that natural water source (Actions 2.2.1, 2.2.3., 2.2.4.).
- Monitor the critical springs in and around the CSU Desert Studies Center for the presence of accessible surface water and ensure bighorn access is not impeded by human activities (Actions 2.2.1, 2.2.3., 2.2.4.).
- Assist SCBS (Society for the Conservation of Bighorn Sheep) in installing a WWD in the Cady Mountains to enhance water availability and redundance for the Big Gee WWD area (Action 2.2.8.). Monitor, maintain, and fill when needed (Actions 2.2.4., 2.2.5.). Monitor bighorn use of this WWD and changes to use of adjacent habitat and dynamics in the Cady Peak Deme (Actions 1.3.2. and 1.3.3.).

Demographics:

This subpopulation is native and contains approximately 150-200 sheep (Table 18, Table 19, **Error! Reference source not found.**). The Cady Mountains contain two ewe demes: one around Cady Peak, one in and south of Afton Canyon. The South Soda Mountains make up the third deme in this subpopulation. Cave Mountain is occupied frequently by rams and less frequently by ewes as the main point of overlap between the Afton Canyon and South Soda ranges.

Effective population surveys of the Cady and Soda Mountains have been completed by helicopter. Helicopter surveys are effective and sightability is generally good (>70%). The Cady and Soda Mountains can each be well covered within one seven-hour day of surveys each. Surveying Cave Mountain would require an additional half day.

Camera surveys have been effective in the Cady Mountains (resight ≥ 50%) by placing motion activated cameras at all WWDs, Afton Tinaja, and 3-5 locations in Afton Canyon. While a camera survey could be effective in the Soda Mountains, theft and vandalism of cameras along Zzyzx Road are a concern.

Ground surveys have not been attempted in the Cady Mountains due to the large area and poor visibility around water sources. In the Soda Mountains ground surveys were effective (resight ≥ 50%) in 2018 and 2019 during hot summer months, and morning hours around Zzyzx. However, the addition of the Razor Ranch WWD distributed summer bighorn activity across a larger, and consequently subsequent attempts at ground surveys have been less effective.

Fecal-DNA-mark-recapture surveys could be feasible with substantial effort in the Cady Mountains. The Soda Mountains could be more easily surveyed this way and provide a means of sampling without the risk of stolen cameras, making the Soda Mountains perhaps the most reasonable range for this method. However, other means of surveying this population are likely more efficient.

Cady Peak and Afton Deme

Table 18. Cady Peak and Afton demes demographic data ranging from 1986-2023, using a variety of survey methods including helicopter surveys (Heli), camera surveys, and ground surveys. If a deme isn't specified under Survey Method, then the estimate include both methods.

Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb Ewe	Yrlg/ Ewe	Ram/ Ewe
1986	Heli	4+	-	16	-	0	0	4++
1988	Heli	10+	-	10	-	0	0	1++
2007	Heli	59+	-	33	-	0.2	0	0.64++
2009	Heli	92+	-	37	-	0.4	0	0.41++
2015	Heli	44*	37-58	39*	18-90	0.26	0.26	.89++
2018	Heli	76*	56-114	24*	23-25	0.14	0.11	0.48++
2019	Camera (Cady Peak Only)	-	-	-	-	0.045	0.15	0.45++
2020	Camera	75**	61-93	58**	37-93	0.18	0.19	0.77***
2021	Camera (Afton Only)	46**	24-89	20**	12-35	0.12	0.11	0.43***
2023	Camera	64**	50-82	35**	20-62	0.61	0.19	0.57***

*Simultaneous Double-Count. **Mark-Resight. +Minimum Count. ++Ram/Ewe Ratios from minimum counts and simultaneous double counts reflect availability of rams and ewes for sighting during a survey, may not be representative, and most frequently undercount rams.

***Ram and ewe mark-resight estimates where an entire subpopulation is not surveyed may represent different parts of the subpopulation, leading to inaccuracies.

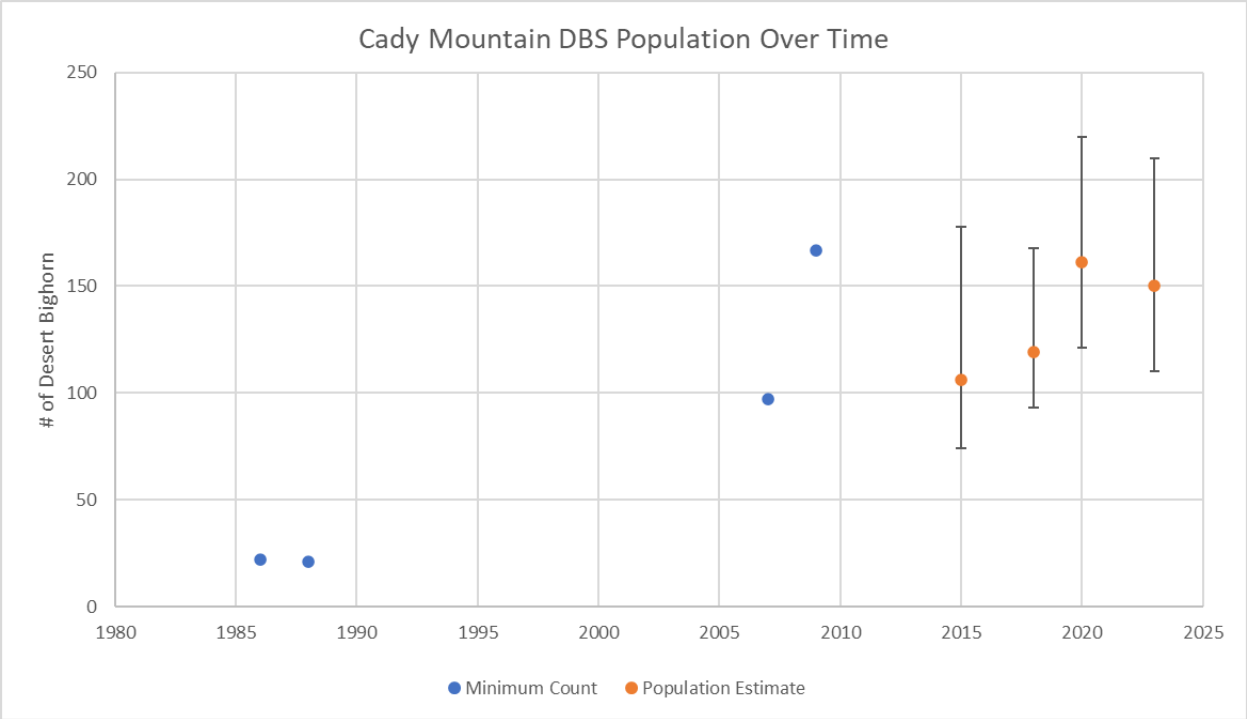

Figure 7. Cady Mountain, including Cady Peak and Afton demes, estimates and minimum counts through time, as presented in Table 19. South Soda deme demographic data ranging from 2018-2024, using a variety of survey methods including helicopter surveys (Heli) and ground surveys.

South Soda Deme

Table 19. South Soda deme demographic data ranging from 2018-2024, using a variety of survey methods including helicopter surveys (Heli) and ground surveys.

Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling/ Ewe	Ram/ Ewe
2018	Ground	34**	17-51	4+	-	0.72	0.19	-
2019	Ground	48**	23-77	18**	7-41	0.44	0.22	.46***
2021	Ground		-		-	0.26	0.26	-
2024	Heli	24*	13-35	17*	9-25	0.59	0.53	0.71++

*Simultaneous Double-Count. **Mark-Resight. +Minimum Count. ++Ram/Ewe Ratios from minimum counts and simultaneous double counts reflect availability of rams and ewes for sighting during a survey, may not be representative, and most frequently undercount rams.
***Ram and ewe mark-resight estimates where an entire subpopulation is not surveyed may represent different parts of the subpopulation, leading to inaccuracies.

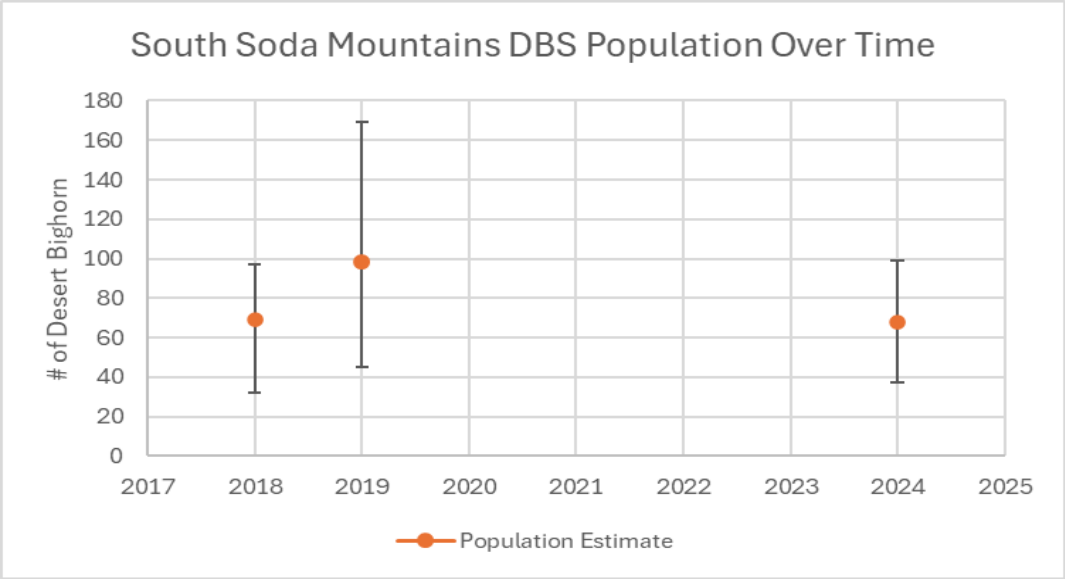

Figure 8. South Soda Mountains (deme) estimates and minimum counts through time, as documented in Table 19. South Soda deme demographic data ranging from 2018-2024, using a variety of survey methods including helicopter surveys (Heli) and ground surveys.

Management Recommendations:

- Capture and collar desert bighorn at a 4–5-year interval in the Afton Canyon, Cady Mountain, and South Soda demes (Action 1.1.2.).
- Conduct a focal estimate every two years in the Afton Canyon and Cady Mountain demes using mark-resight camera surveys. Conduct a comprehensive ground, camera, or helicopter survey every four years in the South Soda Mountains deme with a mark-resight estimate or minimum count (Action 1.1.3).

Mortality Factors:

Disease and nutrition are important factors for the health of the Cady and South Soda Mountains subpopulation (Table 20, Table 21, Table 22). *M. ovipneumoniae* was first detected in the South Soda deme in 2013 (BHS-002, Mojave strain) and the same strain was later detected in the Cady Mountain demes in 2014. Due to a lack of recent population monitoring prior to this outbreak, it is unclear what the population level effects were upon introduction. In the 2021 drought, multiple bighorn mortalities were suspected to be caused by malnutrition, demonstrating this deme's susceptibility to drought.

Other mortality factors include mountain lion (*Puma concolor*) predation. Bighorn sheep have also been killed by trains in Afton Canyon and road mortality has been recorded on I-15 with bighorn attempting to cross into the North Soda Mountains. Furthermore,

there have been several cases of suspected poaching in the Cady Mountains, and one confirmed of a South Soda ewe who had crossed to the north side of I-15.

Table 20. Cady and South Soda subpopulation serology results from 2013-2024.

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
SODA	2013	4	0 / 4	0 / 4 (0%)	0 / 4 (0%)	3 / 4 (75%)	0 / 4 (0%)	0 / 4 (0%)	0 / 4 (0%)	0 / 4 (0%)	1 / 4 (25%)	3 / 4 (75%)	2 / 4 (50%)
CADY	2014	10	0 / 10	0 / 10 (0%)	0 / 10 (0%)	10 / 10 (100%)	0 / 10 (0%)			0 / 10 (0%)	7 / 9 (78%)	6 / 10 (60%)	0 / 10 (0%)
SODA	2015	6	0 / 6	0 / 6 (0%)	0 / 6 (0%)	1 / 6 (17%)	0 / 6 (0%)			0 / 6 (0%)	1 / 6 (17%)	2 / 6 (33%)	0 / 6 (0%)
CADY	2018	10	3 / 7	0 / 10 (0%)	0 / 10 (0%)	7 / 10 (70%)	0 / 20 (0%)	0 / 10 (0%)		0 / 10 (0%)	7 / 8 (88%)	4 / 10 (40%)	0 / 10 (0%)
SODA	2018	7	2 / 5	0 / 7 (0%)	0 / 7 (0%)	6 / 7 (86%)	0 / 12 (0%)	0 / 6 (0%)		0 / 7 (0%)	4 / 7 (57%)	1 / 6 (17%)	0 / 6 (0%)
CADY	2020	10	4 / 6	0 / 9 (0%)	0 / 9 (0%)	4 / 9 (44%)	0 / 9 (0%)	0 / 9 (0%)		0 / 9 (0%)	7 / 9 (78%)	1 / 9 (11%)	0 / 9 (0%)
SODA	2020	14	5 / 9	0 / 14 (0%)	0 / 14 (0%)	7 / 14 (50%)	0 / 14 (0%)	0 / 14 (0%)		0 / 14 (0%)	4 / 14 (29%)	2 / 14 (14%)	0 / 14 (0%)
CADY	2021	8	3 / 5	0 / 8 (0%)	0 / 8 (0%)	0 / 8 (0%)	0 / 8 (0%)	0 / 8 (0%)		1 / 8 (13%)	1 / 8 (13%)	8 / 8 (100%)	1 / 8 (13%)
CADY	2024	5	3 / 2	0 / 5 (0%)	0 / 5 (0%)		0 / 5 (0%)	0 / 5 (0%)	0 / 5 (0%)	0 / 5 (0%)	4 / 4 (100%)	2 / 5 (40%)	

Serosurveillance is conducted on serum from captured bighorn to assess exposure to common diseases of livestock through antibodies to the following pathogens: Bluetongue Virus (BTV), Epizootic Hemorrhagic Disease Virus (EHDV), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Type 1 & 2 (BVD-1, BVD-2), Parainfluenza Virus Type-3 (PI-3), *Brucella ovis* (Bruc), Contagious Ecthyma (CE), *Anaplasma sp.* (Ana), and *Chlamydia sp.* (Chla).

Table 21. Cady and South Soda subpopulation *Mycoplasma ovipneumoniae* (*M. ovipneumoniae)* Results. “CADY” refers to Cady Peak and Afton demes. Samples are

collected from captured bighorn (cap) as well as opportunistically from harvested and dead bighorn (surv).

Deme	**Year**	**N (cap/surv)**	**Sex (M/F)**	***M. ovipneumoniae* Strain Detected**	**# PCR+ Sequenced**	***M. ovipneumoniae* - PCR**	***M. ovipneumoniae* - ELISA**
CADY	2013	2 (0/2)	2 / 0		0	0 / 2 (0%)	
CADY	2014	11 (10/1)	1 / 10	BHS-002 Mojave	3	4 / 11 (36%)	7 / 10 (70%)
CADY	2017	0 (0/0)	0 / 0		0	1 / 3 (33%)	
CADY	2018	10 (10/0)	3 / 7	BHS-002 Mojave	1	3 / 14 (21%)	4 / 10 (40%)
CADY	2019	0 (0/0)	0 / 0		0	0 / 3 (0%)	
CADY	2020	11 (10/1)	5 / 6		0	0 / 13 (0%)	4 / 9 (44%)
CADY	2021	11 (8/3)	5 / 6	BHS-002 Mojave	1	2 / 11 (18%)	0 / 8 (0%)
CADY	2022	2 (0/2)	2 / 0		0	0 / 2 (0%)	
CADY	2023	3 (0/3)	3 / 0		0	0 / 3 (0%)	
CADY	2024	7 (5/2)	5 / 2		0	0 / 6 (0%)	0 / 5 (0%)
SODA	2013	4 (4/0)	0 / 4		0	0 / 4 (0%)	2 / 4 (50%)
SODA	2015	6 (6/0)	0 / 6		0	0 / 6 (0%)	3 / 6 (50%)
SODA	2018	7 (7/0)	2 / 5		0	0 / 7 (0%)	4 / 7 (57%)
SODA	2020	15 (14/1)	5 / 10		0	0 / 15 (0%)	4 / 14 (29%)
SODA	2021	1 (0/1)	0 / 1		0	0 / 1 (0%)	
SODA	2022	1 (0/1)	0 / 1		0	0 / 1 (0%)	

The PCR (Polymerase Chain Reaction) assay is conducted on nasal swabs and screens for *M. ovipneumoniae* DNA, suggesting an active infection in the population. PCR positives are occasionally sequenced to identify the strain circulating in the population. The ELISA test screens for antibodies in serum from captured bighorn to *M. ovipneumoniae* and if positive suggests prior exposure to the pathogen.

Table 22. Cady and South Soda Mountain selenium results.

Deme	Se PPM (CI95)
CADY	0.29, n=42 (0.27, 0.3)
SODA	0.28, n=31 (0.26, 0.3)

Blood Selenium (Se) is occasionally tested from captured bighorn (Table 22). The results are reported as the average blood/serum concentration for all samples, the number of samples tested and a 95% confidence interval of the mean. Normal Selenium for desert bighorn sheep in California has been shown as 0.09–0.49ppm (Poppenga et al. 2012). Lower selenium levels have been shown to reduce survival perhaps by reducing immune function (Tsuchida et al. 2024); however, this has not been documented in California and therefore has not resulted in any management actions.

Management Recommendations:

- Monitor for disease and mitigate if possible (Actions 1.1.2-1.2.7).

Translocation History:

As of 2025, there have been no translocations of desert bighorn into or out of this subpopulation and there are no planned translocations for this subpopulation.

Public Use:

The Cady and South Soda subpopulation provides a variety of opportunities for aesthetic, educational, and recreational use of desert bighorn. Afton Canyon and Zzyzx Road provide some of the best year-round opportunities for public viewing of desert bighorn in the NCDBCU. Desert bighorn can be spotted from the road in both areas. The Cady Mountains Hunt Zone (Hunt Code 509, Zone 9) was established in 2011 and provides a quota up to four general hunt tags per year. The success rate for hunter harvest is typically 100% per season.

Management Recommendations:

- Use findings of population surveys to determine population size and demographic projections to set tag quotas for Zone 9, Cady Mountains (Action 3.1.1. and 3.1.2.).

- Evaluate habitat use through GPS collar and population data to identify potential impacts of off-roading and trains in Afton Canyon. Work with land managers and train company to mitigate impacts if found (Actions 2.5.1.-2.5.4.).
- Coordinate with academic institutions and MOJA to install a bighorn sheep traffic sign at the north end of Zzyzx Road (Actions 1.2.8 and 2.5.2).
- Coordinate with academic institutions and MOJA to provide educational materials at the Desert Studies Center's visitor kiosk off Zzyzx Road (Action 3.2.1.).
- Coordinate with BLM to provide educational materials on desert bighorn ecology and road safety at the Afton Canyon Campground kiosk (Action 3.2.1.).

Old Dad Peak and Indian Spring Subpopulation

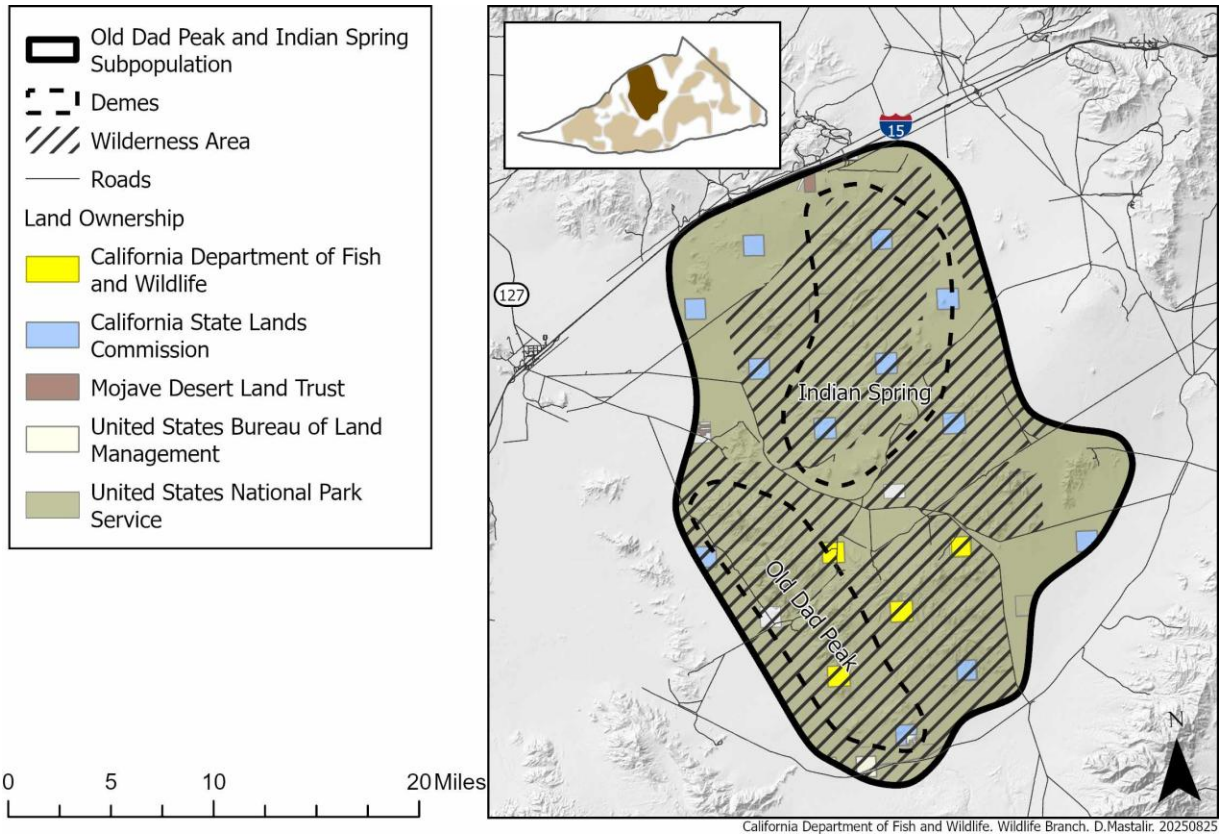

Figure 9. Map of Old Dad Peak and Indian Spring subpopulation and Old Dad Peak and Indian Spring demes.

The Old Dad Peak and Indian Spring subpopulation is located south of Interstate 15 in the central part of the BCU. Much of the land was managed by BLM until 1994 when Congress transferred administration to the National Park Service (NPS) via the Desert Protection Act and established the Mojave National Preserve (MOJA). Collar data indicates movement between this subpopulation and transient habitat in the Cowhole Mountains to the northwest and the North Bristol Mountains to the southwest.

Conservation Concerns:

- Roadway collisions with bighorn sheep occur annually along the portion of Kelbaker Road that bisects this subpopulation.
- The non-native burro (*Equus asinus*) population poses concerns for competition for forage and water. The destruction of natural springs in the Indian Spring area is of particular concern. In 2024, the MOJA removed 54 burros from the Indian Spring Area. MOJA staff are working with Department staff to monitor the prevalence of burros.
- A high voltage transmission line bisects desert bighorn habitat on Old Dad Peak through Jackass Canyon. The Department has recommended that the power

company avoids helicopters and heavy machinery on this powerline during lambing season.

Habitat Condition:

This subpopulation occupies over 300 square miles of well-connected habitat ranging from 1500 ft on the west side of Old Dad Peak to 4952 ft on Club Peak in the East. Habitat is typical of the Mojave Desert (CDFW 1987) and largely consists of creosote bush scrub, desert wash, and Joshua tree (*Yucca brevifolia*) woodland (Paysen et al. 1980). This subpopulation has access to water in natural springs in its eastern range, tinajas in the large limestone mass of Old Dad Peak, as well as WWDs installed in cooperation with BLM and now maintained in cooperation with the NPS.

Four WWDs were added to the range from 1975-1985, though these have been degraded by decades of harsh environmental conditions leading to a need for significant maintenance and/or upgrades. In 2019, in cooperation with the MOJA and SCBS, the Old Dad Peak WWD was upgraded including: increasing storage capacity, replacing damaged tanks and collection pipes, and rebuilding and sealing the collection dam. In 2021, MOJA placed a temporary tank, called Vermin 2 WWD, near the Vermin WWD. In 2023, MOJA placed another temporary tank, called Kerr 2 WWD, near the Kerr WWD. If desert bighorn adapt to using the two new temporary WWDs, these systems will eventually be replaced with permanent systems. The timeline for replacement will depend on how quickly bighorn adapt to the new locations, MOJA staffing, and funding. MOJA and or Department staff check each WWD in the spring and fall to monitor water levels and check for any need system repairs. WWD water levels are also monitored throughout the summer by remote monitoring systems or MOJA staff.

In December 2024, MOJA staff removed 54 burros from the Indian Spring area. Transient burros have also been observed at the temporary WWD referred to as Vermin 2 and the WWDs in Jackass Canyon. As of 2025, MOJA staff estimate there are 25 burros remaining in this area.

Management Recommendations:

- Monitor springs and WWDs for sign and presence of burros and cooperate with the MOJA on any burro removal projects (Actions 2.4.1. and 2.4.3.).
- Work with MOJA to monitor, maintain, and ensure consistent water availability of the critical WWDs: Vermin 2, Old Dad Peak, and Kerr (Actions 2.2.4. and 2.2.5.).
- Work with MOJA to monitor, maintain, and fill the Kerr 2 WWD (Actions 2.2.4. and 2.2.5.). Monitor for increased bighorn use and changes to habitat use by the Old Dad Peak deme (Action 1.3.2. and 1.3.3.).
- Work with MOJA to monitor and maintain the Vermin WWD (Actions 2.2.4. and 2.2.5.).
- Work with MOJA to monitor, maintain, and fill the Kelso WWD (Actions 2.2.4. and 2.2.5.). Modernize the Kelso WWD.

- After analyzing and mitigating potential impacts, work with MOJA to create permanent installations at Vermin 2 and Kerr 2 WWDs, prior to the potential removal of Kerr and Vermin WWDs from wilderness (Actions 2.2.5. and 2.2.7.).
- Monitor Lava Bed Springs and the critical water source of Cane Springs for presence of accessible surface water especially during periods of drought, and signs of excess burro use (Actions 2.2.1., 2.2.6., 2.4.1.). If springs go dry, discuss water supplementation options with MOJA. Work with MOJA to install burro fencing at key water access points (Action 2.4.3.).

Demographics:

This subpopulation is native and contains approximately 150-200 desert bighorn in the northern end of the NCDBCU (Figure 9). This complex of well-connected ranges in the north-central region of this BCU supports one deme around Old Dad Peak in the western end of the range and one near Indian Spring. Camera and collar data demonstrate that the Old Dad Peak deme consists of at least two groups of ewes: one around the Vermin WWD and one around the Kerr WWD, with overlap at the Old Dad Peak WWD. This Old Dad Peak WWD is therefore considered important for connectivity and helps merge the two groups into a single deme (as defined in this document), with some individuals moving between groups. The Kelso Mountain area is predominantly used by rams.

Effective helicopter surveys have been conducted across the Old Dad and Indian Springs subpopulation and require most of two seven-hour days of flight time (Table 23, Figure 10). Re-sight was better at Indian Spring (75%) than Old Dad Peak (33%), likely because of Indian Spring's less complex terrain.

Camera surveys have proven effective and efficient across the range (resight ≥80%), with cameras placed at all WWDs, several spots at Cane Springs, and at Lava Bed Spring. Smaller annual camera surveys of the Old Dad Peak deme have provided resight rates of over 80% for ewes within that deme.

Ground surveys are unlikely to be effective due to the vastness of the terrain. Fecal-mark-recapture surveys are not advised because important water sources can be difficult for humans to access mid-summer.

Table 23. Old Dad and Indian Spring subpopulation demographic data ranging from 2015-2024, using a variety of survey methods including field observations (FieldObs), helicopter surveys (Heli), and camera surveys.

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling/ Ewe	Ram/ Ewe
Both	1979	FieldObs	33+	-	6+	-	0	0	0.18++
Both	1981	Heli	28+	-	22+	-	0.36	0.14	0.79++
Both	1982	Heli	65+	-	77+	-	0.74	-	1.18++

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling/ Ewe	Ram/ Ewe
Both	1985	Heli	65+	-	25+	-	0.6	-	0.38++
Both	1986	Heli	76+	-	3+	-	0.5	-	0.04++
Both	1988	FieldObs	11+	-	44+	-	0.18	0.18	4.00++
Both	1992	Heli	133*	-	84*	-	0.47	0.17	0.63++
Both	1993	Heli	101*	-	71*	-	0.63	0.22	0.70++
Both	1994	Heli	83*	-	71*	-	0.16	0.1	0.86++
Both	1996	Heli	28+	-	24+	-	0.29	0.07	0.86++
Both	1997	Heli	27+	-	14+	-	0.93	0.04	0.52++
Both	1998	Heli	56+	-	34+	-	0.41	0	0.61++
Both	1999	Heli	40+	-	41+	-	0.23	0.2	1.03++
Both	2000	Heli	59+	-	42+	-	0.22	0.15	0.71++
Both	2001	Heli	38+	-	29+	-	0.82	0.13	0.76++
Both	2002	Heli	65+	-	35+	-	0.11	0.14	0.54++
Both	2003	Heli	30+	-	41+	-	0.63	0	1.37++
Both	2004	Heli	60+	-	40+	-	0.83	0.15	0.67++
Both	2005	Heli	78+	-	66+	-	0.45	0.15	0.85++
Both	2006	Heli	92+	-	51+	-	0.17	0.03	0.55++
Old Dad Peak	2015	Heli	68*	29-107	-	-	0.33	0	0.73++
Both	2016	Heli	70**	34-106	13+	9-21	0.05	0	0.27++
Old Dad Peak	2017	Camera	36**	28-47	28**	19-42	0.34	0.06	.78**
Old Dad Peak	2018	Camera	46**	34-61	46	18-35	0.41	0.22	1***
Indian Spring	2018	Heli	23**	18-28	11+	-	0.19	0.31	0.88++
Old Dad Peak	2019	Camera	42**	30-58	-	-	0.65	0.21	-
Old Dad Peak	2019	Camera	31**	24-41	38**	21-69	0.55	0.38	1.22***
Old Dad Peak	2020	Camera	50**	41-61	44**	28-70	0.42	0.28	0.88***
Old Dad Peak	2021	Camera	62**	48-80	52**	31-99	0.14	0.09	.84***
Old Dad Peak	2022	Camera	54**	39-76	52**	25-107	0.46	0.1	.96***

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling/ Ewe	Ram/ Ewe
Old Dad Peak	2023	Camera	34**	23-50	34**	11-111	0.44	0.34	1***
Both	2024	Camera	68**	51-91	60**	37-99	.59	.53	.88***

*Simultaneous Double-Count. **Mark-Resight. +Minimum Count. ++Ram/Ewe Ratios from minimum counts and simultaneous double counts reflect availability of rams and ewes for sighting during a survey, may not be representative, and most frequently undercount rams. ***Ram and ewe mark-resight estimates where an entire subpopulation is not surveyed may represent different parts of the subpopulation, leading to inaccuracies.

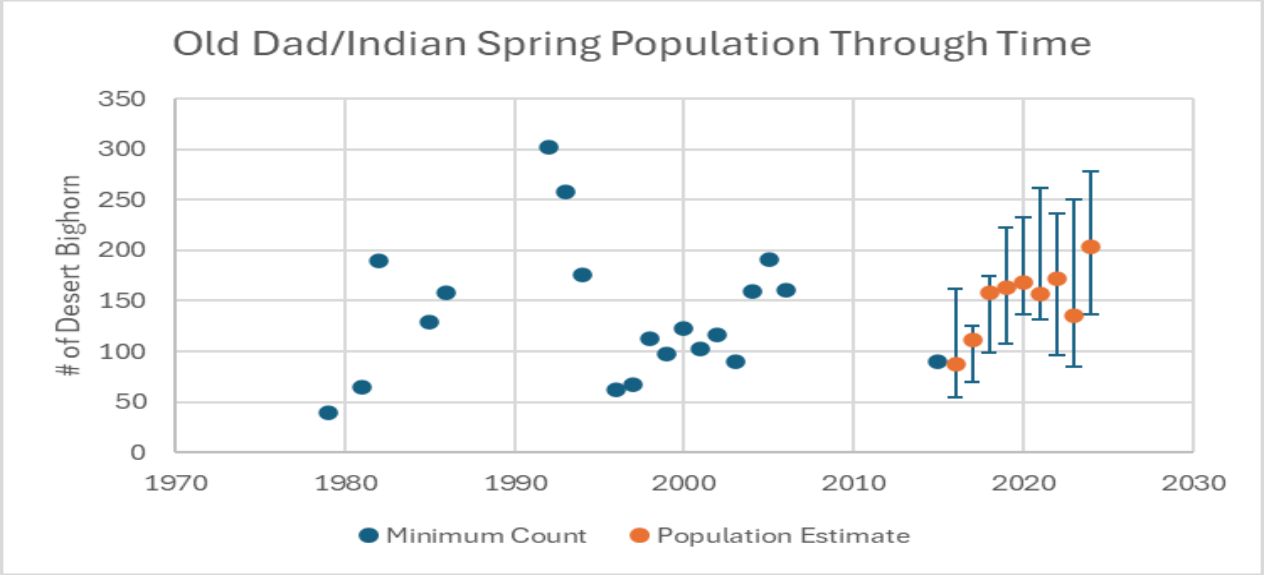

Figure 10. Old Dad Peak and Indian Spring subpopulation estimates and minimum counts through 1979-2024, as documented in Table 23. A substantial decline in the subpopulation in 2013 corresponded with the introduction of a new strain of *Mycoplasma ovipneumoniae (BHS-002 Mojave Strain).*

Management Recommendations:

- Capture and collar desert bighorn at 4–5-year intervals in the Old Dad deme. (Action 1.1.2.).
- Conduct a camera survey with a mark-resight estimate annually in the Old Dad Mountain deme. Conduct a camera survey with a mark-resight estimate every four years in the Indian Springs deme (Action 1.1.3).

Mortality Factors:
Disease is an important mortality factor for the health of the Old Dad Peak and Indian Spring subpopulation (Table 24, Table 25,

Table 26). The *M. ovipneumoniae* strain (BHS-002) specific to the Mojave was first detected in the Old Dad Peak deme in 2013. The strain caused a die-off of over half the population that year, and depressed recruitment until 2016. Since 2017, that deme has experienced a slow but consistent recovery (recruitment ratios of .21 to .38 yearlings:ewes), with a brief lapse in 2021 and 2022 when severe drought depressed bighorn recruitment across the Mojave Desert. The Mojave strain of *M. ovipneumoniae* has since spread as far north as the White Mountains in California, into Nevada and Arizona, causing die-offs in numerous other populations.

Multiple vehicle collisions have also occurred along Kelbaker Road, north of Kelso Depot. Along with some instances of predation.

Table 24. Old Dad and Indian Spring subpopulation serology results.

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
ODKM	1992	18	0 / 18	1 / 32 (3%)	0 / 3 (0%)	0 / 16 (0%)	0 / 16 (0%)		2 / 5 (40%)	0 / 16 (0%)	11 / 13 (85%)	16 / 16 (100%)	3 / 15 (20%)
ODKM	1993	9	6 / 3	0 / 19 (0%)	0 / 2 (0%)	0 / 2 (0%)	0 / 7 (0%)	0 / 2 (0%)	1 / 8 (13%)	0 / 17 (0%)	1 / 17 (6%)	9 / 9 (100%)	5 / 9 (56%)
ODKM	1995	5	0 / 5	0 / 10 (0%)	0 / 5 (0%)	0 / 5 (0%)		0 / 5 (0%)	1 / 5 (20%)	1 / 5 (20%)	3 / 4 (75%)	5 / 5 (100%)	0 / 5 (0%)
ODKM	1997	2	0 / 2	0 / 4 (0%)	0 / 2 (0%)	0 / 2 (0%)	0 / 2 (0%)	0 / 2 (0%)	0 / 2 (0%)	0 / 2 (0%)	0 / 2 (0%)	2 / 2 (100%)	0 / 2 (0%)
ODKM	1998	3	0 / 3	0 / 6 (0%)	0 / 3 (0%)	0 / 3 (0%)		0 / 3 (0%)	3 / 3 (100%)	0 / 3 (0%)	2 / 3 (67%)	3 / 3 (100%)	1 / 3 (33%)
ODKM	1999	1	1 / 0						0 / 1 (0%)				
ODKM	2005	9	0 / 9	0 / 18 (0%)	0 / 9 (0%)	0 / 9 (0%)		0 / 9 (0%)	0 / 9 (0%)	0 / 9 (0%)	8 / 9 (89%)	9 / 9 (100%)	0 / 9 (0%)
ODKM	2006	4	0 / 4	0 / 4 (0%)	0 / 4 (0%)	0 / 4 (0%)	0 / 3 (0%)	0 / 4 (0%)		0 / 4 (0%)	2 / 4 (50%)	3 / 3 (100%)	0 / 4 (0%)
ODKM	2013	19	0 / 19	0 / 19 (0%)	0 / 19 (0%)	11 / 19 (58%)	0 / 19 (0%)	0 / 19 (0%)	0 / 19 (0%)	0 / 19 (0%)	9 / 18 (50%)	19 / 19 (100%)	3 / 19 (16%)
ODKM	2015	7	3 / 4	0 / 7 (0%)	0 / 7 (0%)	2 / 7 (29%)	0 / 7 (0%)			0 / 7 (0%)	1 / 7 (14%)	7 / 7 (100%)	0 / 7 (0%)

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
ODKM	2017	13	5 / 8	0 / 12 (0%)	0 / 12 (0%)	1 / 12 (8%)	0 / 10 (0%)	0 / 2 (0%)		0 / 13 (0%)	6 / 8 (75%)	10 / 10 (100%)	0 / 9 (0%)
ODKM	2018	4	2 / 2	0 / 4 (0%)	0 / 4 (0%)	0 / 4 (0%)	0 / 8 (0%)	0 / 4 (0%)		0 / 4 (0%)	3 / 3 (100%)	4 / 4 (100%)	0 / 4 (0%)
ODKM	2020	14	4 / 10	0 / 14 (0%)	0 / 14 (0%)	1 / 14 (7%)	0 / 14 (0%)	0 / 14 (0%)		0 / 14 (0%)	4 / 14 (29%)	14 / 14 (100%)	0 / 14 (0%)
ODKM	2024	7	5 / 2	0 / 7 (0%)	0 / 7 (0%)		0 / 7 (0%)	0 / 7 (0%)	0 / 7 (0%)	0 / 7 (0%)	7 / 7 (100%)	7 / 7 (100%)	

Serosurveillance is conducted on serum from captured bighorn to assess exposure to common diseases of livestock through antibodies to the following pathogens: Bluetongue Virus (BTV), Epizootic Hemorrhagic Disease Virus (EHDV), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Type 1 & 2 (BVD-1, BVD-2), Parainfluenza Virus Type-3 (PI-3), Brucella ovis (Bruc), Contagious Ecthyma (CE), Anaplasma sp. (Ana), and Chlamydia sp. (Chla).

Table 25. Old Dad and Indian Spring subpopulation *Mycoplasma ovipneumoniae (M. ovipneumoniae)* results. Samples are collected from captured bighorn (cap) as well as opportunistically from harvested and dead bighorn (surv).

Deme	Year	N (cap/ surv)	Sex (M/ F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
ODKM	1992	18 (18/0)	0 / 18		0		0 / 1 (0%)
ODKM	1993	9 (9/0)	6 / 3		0		3 / 6 (50%)
ODKM	1995	5 (5/0)	0 / 5		0		0 / 3 (0%)
ODKM	1997	2 (2/0)	0 / 2		0		1 / 2 (50%)
ODKM	1998	3 (3/0)	0 / 3		0		0 / 3 (0%)
ODKM	1999	1 (1/0)	1 / 0		0		1 / 1 (100%)
ODKM	2005	9 (9/0)	0 / 9		0		0 / 9 (0%)

Deme	Year	N (cap/ surv)	Sex (M/ F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
ODKM	2006	4 (4/0)	0 / 4		0		0 / 4 (0%)
ODKM	2013	36 (19/17)	11 / 25	BHS-002 Mojave	9	18 / 37 (49%)	13 / 19 (68%)
ODKM	2015	7 (7/0)	3 / 4		0	0 / 7 (0%)	3 / 7 (43%)
ODKM	2017	13 (13/0)	5 / 8		0	0 / 15 (0%)	2 / 12 (17%)
ODKM	2018	4 (4/0)	2 / 2		0	0 / 5 (0%)	2 / 4 (50%)
ODKM	2019	0 (0/0)	0 / 0		0	0 / 1 (0%)	
ODKM	2020	14 (14/0)	4 / 10		0	0 / 14 (0%)	6 / 14 (43%)
ODKM	2021	2 (0/2)	2 / 0		0	0 / 2 (0%)	
ODKM	2022	1 (0/1)	1 / 0		0	0 / 1 (0%)	
ODKM	2023	1 (0/1)	1 / 0		0	0 / 1 (0%)	
ODKM	2024	7 (7/0)	5 / 2		0	0 / 7 (0%)	1 / 7 (14%)

The PCR assay is conducted on nasal swabs and screens for *M. ovipneumoniae* DNA, suggesting an active infection in the population. PCR positives are occasionally sequenced to identify the strain circulating in the population. The ELISA test screens for antibodies in serum from captured bighorn to *M. ovipneumoniae* and if positive suggests prior exposure to the pathogen.

Table 26. Old Dad and Indian Spring Subpopulation Selenium and Trace Mineral Results.

Deme	Se PPM (CI95)	Ca PPM (CI95)	Cu PPM (CI95)	Fe PPM (CI95)	Mg PPM (CI95)	Ph PPM (CI95)	K mEq/L (CI95)	Na mEq/L (CI95)	Zn PPM (CI95)
ODKM	0.25, n=85 (0.24, 0.26)	97 n=13 (94, 100)	0.95 n=13 (0.83, 1.07)	1.6 n=13 (1.3, 1.8)	30 n=13 (28, 32)	61 n=13 (51, 71)	5.3 n=13 (4.6, 6)	160 n=13 (157, 164)	1, n=13 (0.9, 1.2)

Blood Selenium (Se) is occasionally tested from captured bighorn. The results are reported as the average blood/serum concentration for all samples, the number of samples tested and a 95% confidence interval of the mean. Normal Selenium for desert bighorn sheep in California has been shown as 0.09–0.49ppm (Poppenga et al. 2012). Lower selenium levels have been shown to reduce survival perhaps by reducing immune function (Tsuchida et al. 2024).

Management Recommendations:

- Monitor for disease and mitigate if possible (Actions 1.1.2-1.2.7).

Translocation History:

From 1983 to 1992, this subpopulation was the main source for translocation stock, with over 200 sheep translocated to other ranges (Table 27; Bleich et al. 1990, Bleich et al. 2021). Future translocation efforts may be considered on a case-by-case basis, though not without consideration of risk of pathogen transmission.

Table 27. Translocation history of the Old Dad Peak and Indian Spring subpopulation from 1983-1992.

Year	Source	Moved to	Females			Males			Total	Citation
			adults	year-lings	lambs	adult	year-lings	lambs		
1983	Old Dad	Whipple Mts.	2	3	0	1	1	2	9	Bleich et al. 1990
1983	Old Dad	Eagle Crags	5	0	4	3	1	4	17	Bleich et al. 1990
1984	Old Dad	Whipple Mts.	6	2	2	4	1	1	16	Bleich et al. 1990
1984	Old Dad	Sheep Hole Mts.	7	0	0	3	0	1	11	Bleich et al. 1990
1985	Old Dad	Whipple Mts.	4	1	2	1	1	0	9	Bleich et al. 1990
1985	Old Dad	Sheep Hole Mts.	8	1	3	2	0	2	16	Bleich et al. 1990
1986	Old Dad	Argus Range	16	3	2	5	0	2	28	Bleich et al. 1990
1987	Old Dad	Eagle Crags	7	2	2	3	1	1	16	Bleich et al. 1990

Year	Source	Moved to	Females			Males			Total	Citation
			adults	year-lings	lambs	adult	year-lings	lambs		
1989	Old Dad	Chuckwalla Mts.	28	9	0	2	4	0	43	Bleich et al. 2021
1992	Old Dad	North Bristol Mts.	13	2	0	0	4	1	21	Bleich et al. 2021
1992	Old Dad	Sheep Hole Mts.	0	0	0	3	0	1	4	Bleich et al. 2021
1992	Old Dad	Bullion Mts.	13	2	0	1	2	1	19	Bleich et al. 2021
		Total	96	23	15	28	13	15	209	

Public Use:

The Old Dad Peak and Indian Spring subpopulation provides some opportunities for aesthetic, educational, and recreational use (including hunting) of desert bighorn. Desert bighorn can occasionally be spotted from the road in Jackass Canyon and members of the public should use caution while driving in this area.

The Old Dad and Kelso Peak Mountains Hunt Zone (Hunt Code 502, Zone 2) was established in 1987 as one two of the first hunt zones. The success rate for hunter harvest is typically 100% per season.

Management Recommendations:

- Use findings of population surveys to set tag quotas for Zone 2, Old Dad and Kelso Peak Mountains (Action 3.1.1. and 3.1.2.).

North Bristol and Granite Mountains Subpopulation

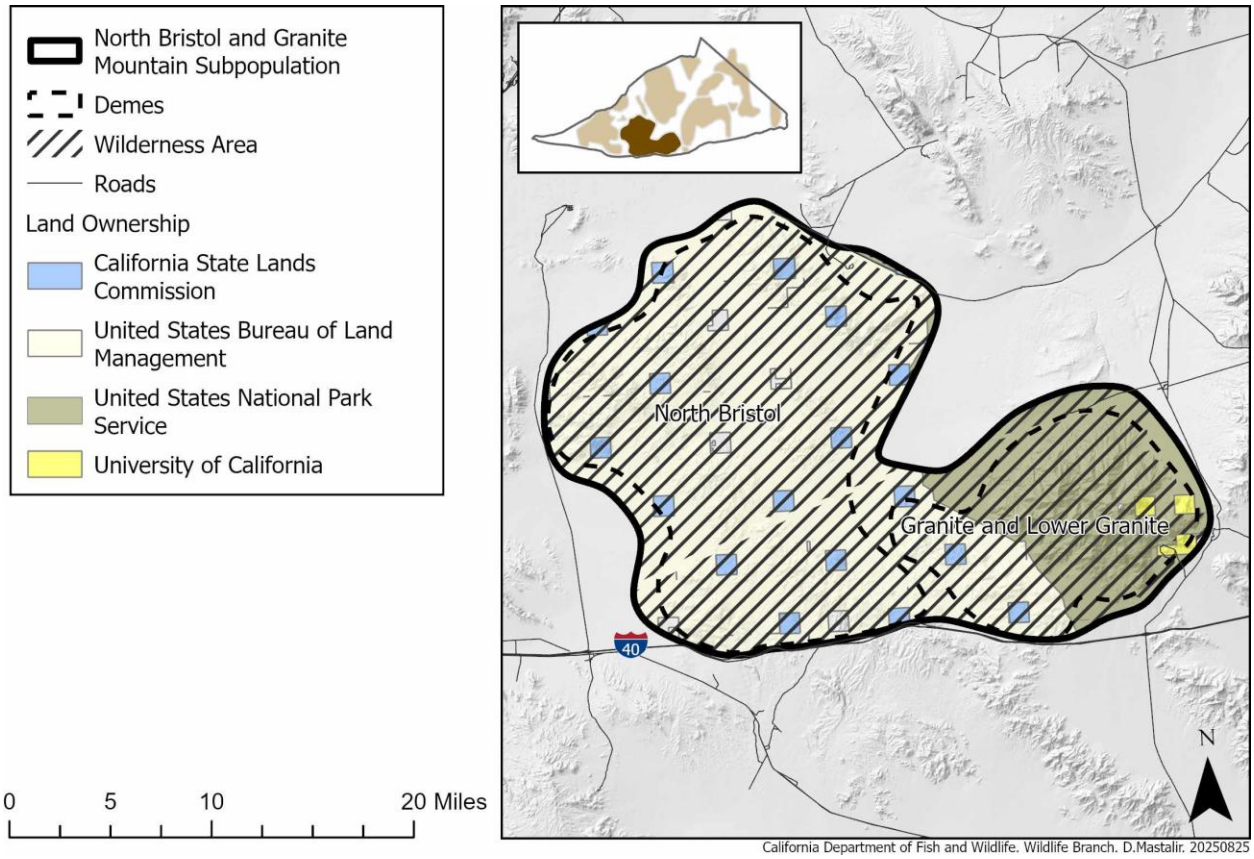

Figure 11. Map of North Bristol and Granite Mountains subpopulation, plus the North Bristol, Granite and Lower Granite demes.

The North Bristol and Granite Mountains are located in central San Bernardino County (Figure 11), north of I-40, east of the Cady Mountains, along the west boundary of the Mojave National Preserve. Prior to the construction of I-40 in the early 1970s, there was continuous habitat between the North Bristol and the South Bristol Mountains. The North Bristol Mountains are also closely connected with the Cady Mountains, while the Granite Mountains show connectivity with the Providence Mountains. The range at the southwestern base of the Granite Mountains is called Old Dad Mountains on USGS (United States Geological Survey) maps, however, to avoid confusion with Old Dad Peak (just to the north), the Old Dad Mountains will be hereafter referred to as the Lower Granite Mountains.

As of 2025, no burros have been found at water sources monitored by the Department. However, there are known burro populations within MOJA to the northeast and along the north end of the Granite Mountains. Therefore, the burro population poses a concern for potential competition for forage and water. Mountain lion predation may have been a significant threat in the past. Wehausen (1996) suggests that persistent mountain lion predation previously posed threats to this population. While 25% of

mortalities investigated since 2013 in this subpopulation showed signs of mountain lion predation, survival rates showed no significant change over this period.

Conservation Concerns:

- I-40 separates this subpopulation from the South Bristol and Marble Mountains, inhibiting connectivity.

Habitat Condition:

These ranges cover an area of roughly 300 square miles, largely between 2,000 and 3,500 ft of elevation in the North Bristol and Lower Granite Mountains, but up to 6,738 ft on Granite Mountain. Vegetation consists largely of creosote and wash scrub in the lower ranges, with more varied woody and succulent scrub on Granite Mountain with pinyon (*Pinyon spp.*) juniper (*Juniperus spp.*) woodlands near the summit. Water is limited in the North Bristol Range, with a pair of WWDs (Hyten Spring and Hyten Tank) to the north, and several large tinajas located in the center on Broadwell Mesa while Granite Mountain contains numerous perennial springs and relatively abundant water.

Burros are present on the north end of Granite Mountain overlapping with bighorn habitat largely in canyons and washes. Based on camera surveys, both the Hyten Spring and Hyten Tank WWDs are used regularly by desert bighorn. The North I-40 WWD was installed at the southern end of the North Bristol Mountains by Caltrans as mitigation for the construction of I-40 in 1974. However, following upgrades to highway drainage and continued flash flood damage, this WWD is no longer functional and being evaluated for either repair or removal pending collection of more data. In 2025, a new WWD (Catfish) was constructed central to the North Bristol Mountains, south of Broadwell Mesa.

Management Recommendations:

- Collaborate with partners to continue to monitor genetic diversity and gene flow between the North Bristol and Granite subpopulations and the South Bristol and Marble subpopulations south of I-40. (Actions 1.3.1 and 1.3.2.).
- Work with Caltrans and partners to identify locations and construct two wildlife overcrossings, one connecting the North and South Bristol subpopulations, and the other connecting the Granite and Marble subpopulations (Action 1.3.4).
- Monitor springs and WWDs for sign and presence of burros and communicate information to the MOJA and the BLM (Actions 2.4.1. and 2.4.3.).
- Monitor and maintain the Hyten Spring WWD (Actions 2.2.4. and 2.2.5.).
- Monitor, maintain, and ensure constant water availability of the critical Hyten Tank WWD (Actions 2.2.4. and 2.2.5.).
- Monitor the Broadwell Tank tinaja for continued bighorn use and water availability (Action 2.2.4).
- Monitor critical springs in Bull Canyon and West Granite Creek in the Granite Mountains for the presence of accessible surface water especially during periods of drought and signs of burro use (Actions 2.2.1., 2.2.2., 2.2.6., 2.4.1., 2.4.3.).

- Monitor and maintain the North I-40 WWD (Actions 2.2.4. and 2.2.5.).
- Work with SCBS to install one to two new WWDs in the North Bristol Mountains to enhance habitat use and connectivity (Actions 1.1.3. and 2.2.8.).

Demographics:

This subpopulation contains approximately 150-200 desert bighorn (Figure 12, Table 28). The Granite deme is native, but the North Bristol deme established through natural colonization sometime between 2003 and 2013 (the 1992 attempted reintroduction did not establish a resident deme). Collar data from 2013-2024 GPS indicates that the subpopulation is split into two ewe demes. The North Bristol deme ranges over the extent of the North Bristol Mountains using barrel cactus, natural tinajas, and WWDs for water in the summer. The other deme uses the Lower Granite Mountains as winter habitat, moving to the cooler, wetter habitat of Granite Mountain in the summer, though some individuals in this deme have remained in either range year-round. Rams are observed to move throughout the subpopulation.

Helicopter surveys have been successfully conducted throughout the Granite and North Bristol subpopulation with ~80% resight in 2016, 2019, and 2023. Approximately three and a half seven-hour days of flight time are required to effectively survey the entire subpopulation.

While camera surveys at Hyten Tank and Spring have been successful in determining recruitment ratios, a comprehensive camera survey has not yet been attempted. Such a survey is planned in 2025 with cameras at both WWDs, Broadwell Tank, Bull Canyon, and West Granite Canyon.

Ground surveys are unlikely to be effective due to the vast rugged nature of the occupied area. Fecal-mark-recapture is not feasible due to water sources that are prohibitively dangerous for humans to access in the summer.

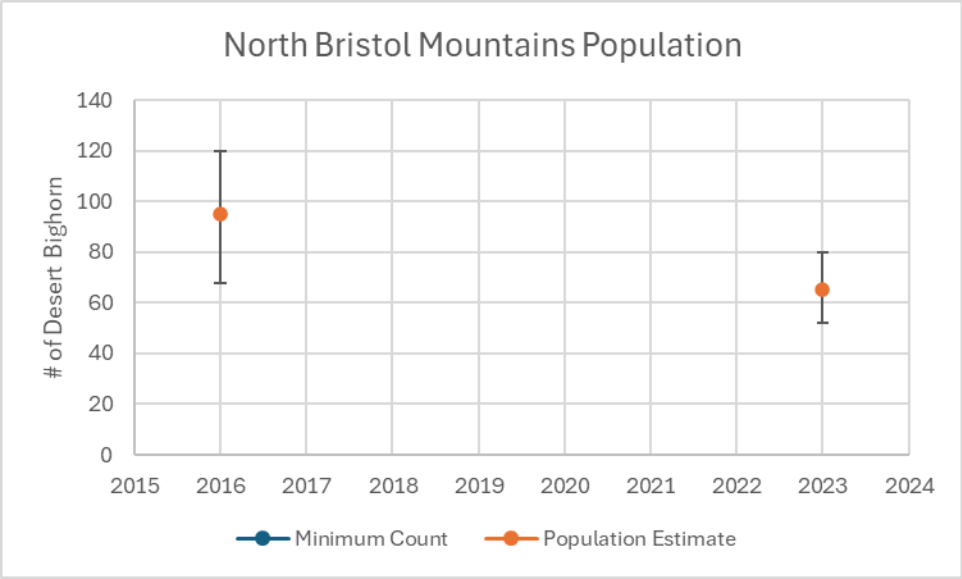

Figure 12. North Bristol Mountains deme estimates through time, as documented in Table 28.

Table 28. Granite and North Bristol subpopulation demographic data ranging from 2016-2025, using a variety of survey methods including helicopter surveys (Heli) and camera surveys.

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling / Ewe	Ram/ Ewe
North Bristol	2016	Heli	58**	41-74	16*	12-19	0.27	0.1	0.53++
North Bristol	2017	Camera	21**	18-42	4+	-	0.28	0.06	-
North Bristol	2018	Camera	-	-	-	-	0.09	0.38	-
North Bristol	2019	Camera	-	-	-	-	0.67	0.09	-
North Bristol	2023	Heli	48*	40-59	17*	13-21	0.625	0.18	0.42++
Granite Mountain	1985	Heli	6+	-	1+	-	.17	0.0	.17++
Granite Mountain	2019	Heli	36**	26-46	25**	14-55	0.46	0.15	0.69++

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling / Ewe	Ram/ Ewe
Both	2025	Camera	56**	28-91	36**	14-100	0.13	0.17	0.64***

*Simultaneous Double-Count. **Mark-Resight. +Minimum Count. ++Ram/Ewe Ratios from minimum counts and simultaneous double counts reflect availability of rams and ewes for sighting during a survey, may not be representative, and most frequently undercount rams. ***Ram and ewe mark-resight estimates where an entire subpopulation is not surveyed may represent different parts of the subpopulation, leading to inaccuracies.

Management Recommendations:

- Capture and collar desert bighorn as time and staffing allow in the North Bristol and Granite Mountains subpopulation (Action 1.1.2.).
- Conduct biennial camera and/or helicopter population surveys in the North Bristol and Granite Mountains (Action 1.1.3).

Mortality Factors:

The Department has been monitoring disease presence in the North Bristol and Granites subpopulation since 1991 (Tables 28, 29, 30). *M. ovipneumoniae* was first documented in these populations in 2013 (BHS-002, Mojave strain). Mountain lion predation may have been responsible for a decline in this subpopulation during the 1990s (Wehausen 1996). Mountain lion presence and predation have been observed in both demes (2013-2020). Roadkill incidents have also occurred along Kelbaker Road.

Table 29. North Bristol and Granite Mountains subpopulation serology results.

Deme	**Year**	**n**	**Sex (M/F)**	**BTV**	**EHDV**	**BRSV**	**BVD-1**	**BVD-2**	***Bruc***	**PI-3**	**CE**	***Ana***	***Chla***
GRAN	1991	1	0 / 1			0 / 1 (0%)	0 / 1 (0%)		0 / 1 (0%)	1 / 1 (100%)			0 / 1 (0%)
BRSN	1992	20	5 / 15	0 / 36 (0%)	0 / 1 (0%)	4 / 20 (20%)	0 / 20 (0%)		3 / 11 (27%)	0 / 20 (0%)	19 / 19 (100%)	16 / 16 (100%)	4 / 28 (14%)
GRAN	1992	1	0 / 1	0 / 1 (0%)	0 / 1 (0%)	1 / 1 (100%)	0 / 1 (0%)			1 / 1 (100%)			0 / 1 (0%)
GRAN	1993	3	0 / 3	0 / 6 (0%)	2 / 1 (200%)	0 / 3 (0%)		0 / 3 (0%)	2 / 2 (100%)	0 / 3 (0%)	0 / 3 (0%)		0 / 3 (0%)
BRSN	2005	2	0 / 2	0 / 4 (0%)	0 / 2 (0%)	0 / 2 (0%)		0 / 2 (0%)		0 / 2 (0%)	2 / 2 (100%)	0 / 2 (0%)	1 / 2 (50%)
BRSN	2013	6	0 / 6	0 / 6 (0%)	0 / 6 (0%)	6 / 6 (100%)	0 / 6 (0%)	0 / 6 (0%)	0 / 6 (0%)	0 / 6 (0%)	5 / 6 (83%)	2 / 6 (33%)	1 / 6 (17%)

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
GRAN	2013	5	1 / 4	0 / 5 (0%)	0 / 5 (0%)	5 / 5 (100%)	0 / 5 (0%)	0 / 5 (0%)	0 / 5 (0%)	0 / 5 (0%)	2 / 5 (40%)	5 / 5 (100%)	2 / 5 (40%)
BRSN	2015	13	4 / 9	0 / 13 (0%)	0 / 13 (0%)	11 / 13 (85%)	0 / 13 (0%)			1 / 13 (8%)	8 / 14 (57%)	10 / 13 (77%)	0 / 13 (0%)
BRSN	2017	3	3 / 0	0 / 3 (0%)	0 / 3 (0%)	2 / 3 (67%)	0 / 3 (0%)	0 / 3 (0%)		0 / 3 (0%)	1 / 2 (50%)	3 / 3 (100%)	1 / 3 (33%)
BRSN	2018	12	6 / 6	0 / 12 (0%)	0 / 12 (0%)	10 / 12 (83%)	0 / 24 (0%)	0 / 12 (0%)		0 / 12 (0%)	10 / 12 (83%)	12 / 12 (100%)	0 / 12 (0%)
GRAN	2018	2	1 / 1	0 / 2 (0%)	0 / 2 (0%)	1 / 2 (50%)	0 / 4 (0%)	0 / 2 (0%)		0 / 2 (0%)	1 / 2 (50%)	2 / 2 (100%)	0 / 2 (0%)
BRSN	2021	8	3 / 5	0 / 8 (0%)	0 / 8 (0%)	1 / 8 (13%)	0 / 8 (0%)	0 / 8 (0%)		0 / 7 (0%)	4 / 8 (50%)	8 / 8 (100%)	0 / 8 (0%)
GRAN	2021	5	2 / 3	0 / 5 (0%)	0 / 5 (0%)	3 / 5 (60%)	0 / 5 (0%)	0 / 5 (0%)		0 / 5 (0%)	3 / 5 (60%)	5 / 5 (100%)	0 / 5 (0%)

Serosurveillance is conducted on serum from captured bighorn to assess exposure to common diseases of livestock through antibodies to the following pathogens: Bluetongue Virus (BTV), Epizootic Hemorrhagic Disease Virus (EHDV), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Type 1 & 2 (BVD-1, BVD-2), Parainfluenza Virus Type-3 (PI-3), Brucella ovis (Bruc), Contagious Ecthyma (CE), Anaplasma sp. (Ana), and Chlamydia sp. (Chla).

Table 30. North Bristol and Granite Mountains subpopulation *Mycoplasma ovipneumoniae* results and stain types.

Deme	Year	N (cap/ surv)	Sex (M/F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
BRSN	1992	20 (20/0)	5 / 15		0		0 / 13 (0%)
GRAN	1992	1 (1/0)	0 / 1		0		0 / 1 (0%)
GRAN	1993	3 (3/0)	0 / 3		0		0 / 3 (0%)
BRSN	2005	2 (2/0)	0 / 2		0		0 / 2 (0%)

Deme	Year	N (cap/ surv)	Sex (M/F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
BRSN	2013	6 (6/0)	0 / 6	BHS-002 Mojave	1	1 / 6 (17%)	2 / 6 (33%)
GRAN	2013	5 (5/0)	1 / 4	BHS-002 Mojave	1	2 / 5 (40%)	2 / 5 (40%)
BRSN	2015	13 (13/0)	4 / 9		0	1 / 13 (8%)	1 / 13 (8%)
BRSN	2017	3 (3/0)	3 / 0		0	0 / 5 (0%)	1 / 3 (33%)
GRAN	2017	0 (0/0)	0 / 0		0	0 / 1 (0%)	
BRSN	2018	12 (12/0)	6 / 6		0	1 / 13 (8%)	2 / 12 (17%)
GRAN	2018	2 (2/0)	1 / 1		0	0 / 3 (0%)	1 / 2 (50%)
GRAN	2019	0 (0/0)	0 / 0		0	0 / 1 (0%)	
GRAN	2020	3 (0/3)	2 / 1		0	0 / 4 (0%)	
BRSN	2021	8 (8/0)	3 / 5		0	0 / 8 (0%)	2 / 8 (25%)
GRAN	2021	5 (5/0)	2 / 3		0	0 / 5 (0%)	1 / 5 (20%)

Samples are collected from captured bighorn (cap) as well as opportunistically from harvested and dead bighorn (surv). PCR positives are occasionally sequenced to identify the strain circulating in the population. The PCR assay is conducted on nasal swabs and screens for *M. ovipneumoniae*. DNA, suggesting an active infection in the

population. The ELISA test screens for antibodies in serum from captured bighorn to *M. ovipneumoniae* and if positive suggests prior exposure to the pathogen.

Table 31. North Bristol and Granite Mountains selenium and trace mineral results.

Deme	Se PPM (CI95)	Ca PPM (CI95)	Cu PPM (CI95)	Fe PPM (CI95)	Mg PPM (CI95)	Ph PPM (CI95)	K mEq/L (CI95)	Na mEq/L (CI95)	Zn PPM (CI95)
BRSN	0.28 ,n=44 (0.26, 0.3)	104 n=2 (87, 120)	1.36 n=2 (0.75, 1.97)	0.9 n=2 (0.3, 1.6)	32 n=2 (28, 37)	73 n=2 (44, 102)	4.9 n=2 (4.1, 5.7)	163 n=2 (155, 171)	0.8, n=2 (0.2, 1.3)
GRAN	0.23 ,n=13 (0.2, 0.25)								

Blood Selenium (Se) is occasionally tested from captured bighorn. The results are reported as the average blood/serum concentration for all samples, the number of samples tested and a 95% confidence interval of the mean. Normal Selenium for desert bighorn sheep in California has been shown as 0.09–0.49ppm (Poppenga et al. 2012). Lower selenium levels have been shown to reduce survival perhaps by reducing immune function (Tsuchida et al. 2024).

Translocation History:

Desert bighorn were reintroduced to the North Bristol range in 1992 using desert bighorn from the adjacent Old Dad Peak deme (Table 322). However, in 2003, only a few transient males were observed. The range was colonized naturally over a decade later. As of 2025, there are no plans for future translocations to augment this subpopulation.

Table 32. Translocation history of the North Bristol and Granite Mountains subpopulation.

Month	Year	Source	Moved to	Females			Males			Total	Citation
				adults	year-lings	lambs	adult	year-lings	lambs		
November	1992	Old Dad	North Bristol	13	2	0	0	4	1	21	Bleich et al. 2021

Public Use:

The North Bristol and Granite Mountains subpopulation provides limited opportunities for aesthetic, educational, and recreational use of desert bighorn due to remoteness and difficulty of access.

The North Bristol and Granite Mountains subpopulation is proposed as a hunt zone. The combined populations of these three demes had a population of over 100 desert

bighorn in 2023, capable of sustaining conservative harvest. While consistent, high-resolution surveys of this range would be too resource intensive, camera surveys with mark-resight estimates based on natural marks, or minimum counts, combined with occasional helicopter surveys will provide sufficient data for recommending a sustainable harvest in this subpopulation. As finer scale data may be cost prohibitive, any proposed quotas will be very conservative. This means that harvest from this zone will likely be lower proportionally than others.

Management Recommendations:

- Use findings from population surveys to provide recommendations for a new hunt zone in this subpopulation (Action 3.1.3.).
- If a new hunt zone is established, continue to conduct population surveys and monitor disease status to inform tag quotas (Actions 3.1.1. and 3.1.2.).

Woods, Hackberry, and Providence Mountains Subpopulation

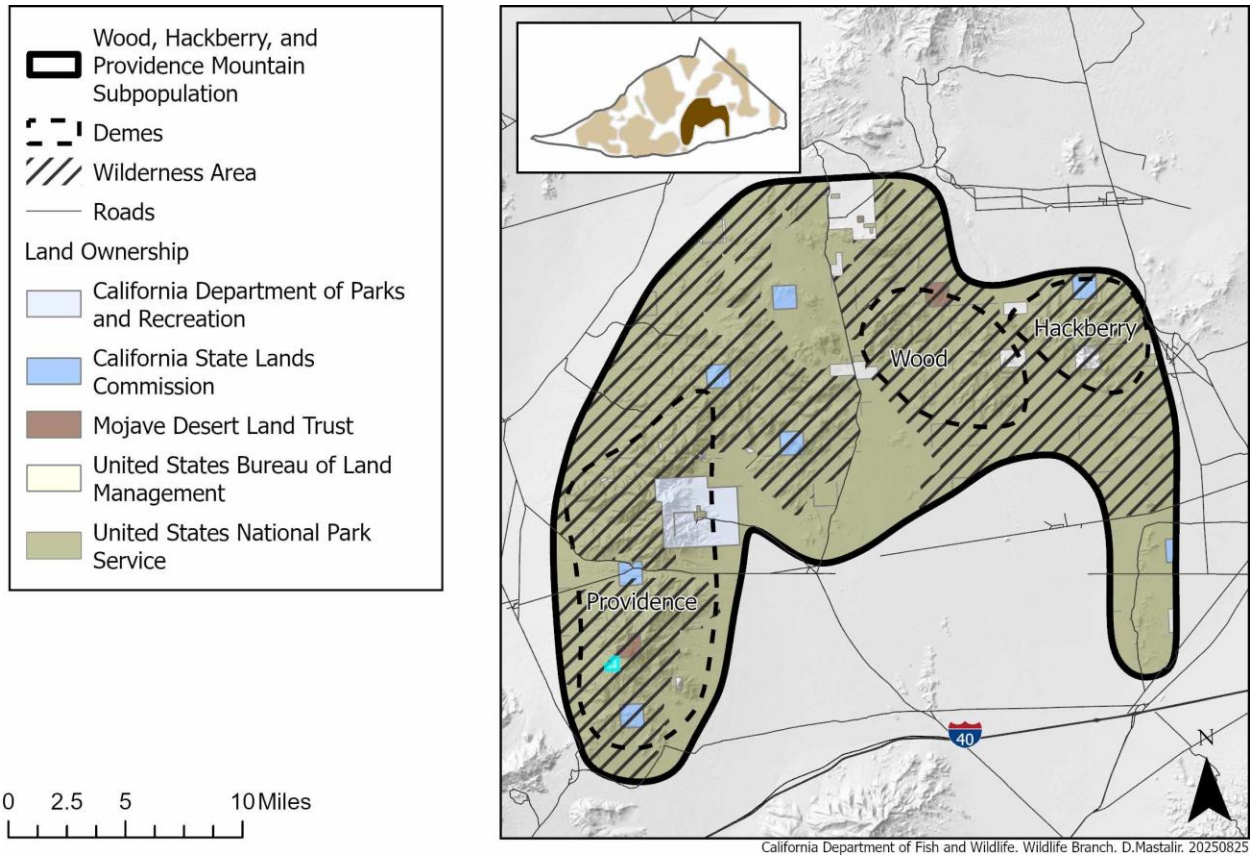

Figure 13. Map of Woods, Hackberry, and Providence Mountains subpopulation and the Woods, Hackberry, and Providence Mountain demes.

The Woods, Hackberry, and Providence Mountains subpopulation is located centrally to the MOJA, and between I-15 (28 miles north) and I-40 (six miles south). The subpopulation is connected through the Providence Mountains to Granite Mountain to the West, and through the Hackberry Mountains to the Piute Mountains to the east (Figure 13).

Conservation Concerns:

- Cattle from grazing allotments (*Bos taurus*) and burro populations pose concerns for competition for forage and water as well as potential disease transmission. Only a few perennial water sources exist that are not currently heavily used by cattle and/or burros. Cooperation with the ranching operations and landowners to increase desert bighorn access to water could prove especially beneficial to that deme.
- Potential ground water pumping projects (e.g. the Cadiz water project) could pump groundwater from important watersheds such as the Fenner Wash and Orange Blossom Wash watersheds to provide water for urban centers such as nearby Los Angeles. Because the water in these underground aquifers collects in

the Woods, Hackberry, and Providence Mountains, it is possible that the groundwater pumping from these aquifers could decrease the number of springs or amount of water flow at these springs in these mountain ranges.
- I-40 separates this subpopulation from the Clipper and South Piute Mountains, inhibiting connectivity.

Habitat Condition:

While the Woods and Hackberry Mountains are relatively small, covering less than 50 square miles at roughly 3,500 to 5,500 ft of elevation, the Providence Mountains cover over 100 square miles and rise to 7,162 ft. The Woods and Hackberry Mountains consist largely of creosote, and catclaw (*Senegalia greggii*)-cholla (Cylindropuntia spp.) scrub, while the Providence Mountains rise to extensive pinyon-juniper woodlands. Surface water is available throughout, in both natural and piped springs.

Deer were introduced into the Providence Mountains through translocation in the 1940s and remain present (CDFG 1991). Feral burros are common in the Providence Mountains and are likely also found in the Woods and Hackberry Mountains. As of 2025, MOJA estimates a population of 125 burros in the Providence Mountains and Hidden Hills area. An active cattle grazing allotment is present (2025) along the eastern side of the Providence Mountains and the southern edge of the Woods Mountains.

Management Recommendations:

- Examine the viability of, and potential locations for, wildlife overcrossings connecting the Woods and Hackberry Mountains south across I-40 to the Clipper and South Piute Mountains using genetic, GPS, telemetry, and observational data. (Actions 1.3.1, 1.3.2., 1.3.4.).
- Monitor the Lower Cornfield Spring in the Providence mountains for water availability and signs of burro use. Work with MOJA to exclude burros if use becomes apparent (Actions 2.2.1., 2.2.2., 2.2.6., 2.4.1., 2.4.3.).
- Monitor the Crystal Adit in Mitchell Caverns State Park. Work with California State Parks to increase water reliability at or near this site for bighorn sheep (Actions 2.2.1., 2.2.2., 2.2.6.).
- Monitor the Woods Spring in the Woods Mountains for water availability, and functionality of the burro exclusion fence (Actions 2.2.1., 2.2.2., 2.2.6., 2.4.1., 2.4.3.).
- Monitor the Hackberry and South Hackberry Springs for water availability and signs for burro use. Work with MOJA to exclude burros if use becomes apparent (Actions 2.2.1., 2.2.2., 2.2.6., 2.4.1., 2.4.3.).
- Work with MOJA to install a WWD in the Vontrigger Hills for increased habitat use and connectivity (Actions 1.3.3. and 2.2.8.).
- Monitor springs and WWDs for sign of the presence of burros and cattle. Cooperate with the MOJA on any burro removal projects (Action 2.4.1.-2.4.3).

- Work with MOJA, State Lands Commission, and local ranchers to consider if there are any suitable locations where cattle and burros could be excluded from natural water sources in the Hackberry and Providence mountains, including Goldstone, Foshay, Summit, Hackberry, and South Hackberry Springs (Actions 2.4.1.-2.4.3.).
- Provide comments and analysis on proposed ground water pumping projects detailing potentially harmful impacts on desert bighorn habitat (Action 1.3.3).

Demographics:

This subpopulation is native and contains 150-200 desert bighorn (Table 33, Figure 14, Figure 15). GPS collar data show two separate ewe demes in the Woods and Hackberry Mountains, separated by Watson Wash, with rams frequently crossing between the ranges. Multiple ewes have been observed making forays during the spring from the Woods to Providence Mountains, likely for lambing. The Providence Mountains hold a third deme.

The Woods and Hackberry demes have been effectively surveyed by helicopter in a single seven-hour flight day with resight rates of up to 80%. The Providence Range has not been surveyed by helicopter in recent years, but would require two to three days, and would likely have worse sightability than the Woods and Hackberries due to complex terrain and vegetation.

A successful camera survey of the Providence Range was conducted in 2022, though with low resolution (resight ≥50%). An attempted camera survey of the entire subpopulation in 2024 only yielded recruitment ratios and minimum counts; however, another attempt will be made in 2026 with adjustments to camera placements. We anticipate that with proper camera placement and dry conditions, a low-resolution mark-resight camera survey is possible.

A ground survey of the Woods and Hackberry Mountains could be attempted, though it would likely require a large team of capable hikers. A ground survey of the Providence Range would not be feasible due to the vast and rugged terrain.

Fecal-mark recapture is unlikely an effective means of surveying because desert bighorn in this subpopulation rely more on succulents for water intake, and less on point water sources.

Table 33. Woods and Hackberry Mountains subpopulation demographic data ranging from 1969-2025, using a variety of survey methods including helicopter surveys (Heli) and camera surveys.

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling / Ewe	Ram/ Ewe	Total Unknown Sex
Woods/ Hackberry	1969	Ground	13+	-	2+	-	0.15	-	0.15++	

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/ Ewe	Yearling / Ewe	Ram/ Ewe	Total Unknown Sex
Providence	1970	Ground	9+	-	2+	-	0.33	0.11	0.22++	
Providence	1971	Ground	11+	-	7+	-	0.63	0.09	0.63++	
Providence	1972	Ground	20+	-	8+	-	0.15	0	0.4++	
Woods/ Hackberry	1974	Heli	-	-	-	-	-	-	-	9
Providence	1974	Heli	-	-	-	-	-	-	-	5
Providence	1975	Heli	-	-	-	-	-	-	-	5
Woods/ Hackberry	1975	Heli	-	-	-	-	-	-	-	6
Woods/ Hackberry	1976	Heli	-	-	-	-	-	-	-	43
Providence	1976	Heli	-	-	-	-	-	-	-	40
Woods/ Hackberry	1984	Heli	9+	-	6+	-	0	0	0.66++	-
Providence	1986	Heli	15+	-	9+	-	0.13	0.13	0.60++	-
Woods/ Hackberry	1986	Ground	15+	-	9+	-	0.33	0.66	0.60++	^^60
Woods/ Hackberry	1987	Ground	30+	-	21+	-	0.20	0.16	0.70++	^^90
Providence	1988	Heli	16+	-	16+	-	0.31	0.13	1.0++	-
Woods/ Hackberry	1988	Ground	23+	-	16+	-	0.22	0.22	0.70++	^^75
Woods/ Hackberry	1988	Heli	10+	-	5+	-	0.20	0.10	0.50++	-
Woods/ Hackberry	2000	Heli	0	-	11+	-	-	-	-	-
Woods/ Hackberry	2005	Heli	12+	-	4+	-	0.08	0.33	0.33++	-
Providence	2005	Heli	0	-	0	-	-	-	-	-
Woods/ Hackberry	2019	Heli	45**	37-54	31*	27-39	0.25	0.11	0.83++	
Providence	2022	Camera	50**	38-72	20**	8-42	0.05	0.33	0.4***	
Woods/ Hackberry	2024	Camera	-	-	10+	-	0.37	0.37	-	
Woods/ Hackberry	2025	Heli	43+	-	22**	17-29	0.07	0.26	0.37++	

*Simultaneous Double-Count. **Mark-Resight. +Minimum Count. ++Ram/Ewe Ratios from minimum counts and simultaneous double counts reflect availability of rams and ewes for sighting during a survey, may not be representative, and most frequently undercount rams.

***Ram and ewe mark-resight estimates where an entire subpopulation is not surveyed may represent different parts of the subpopulation, leading to inaccuracies.

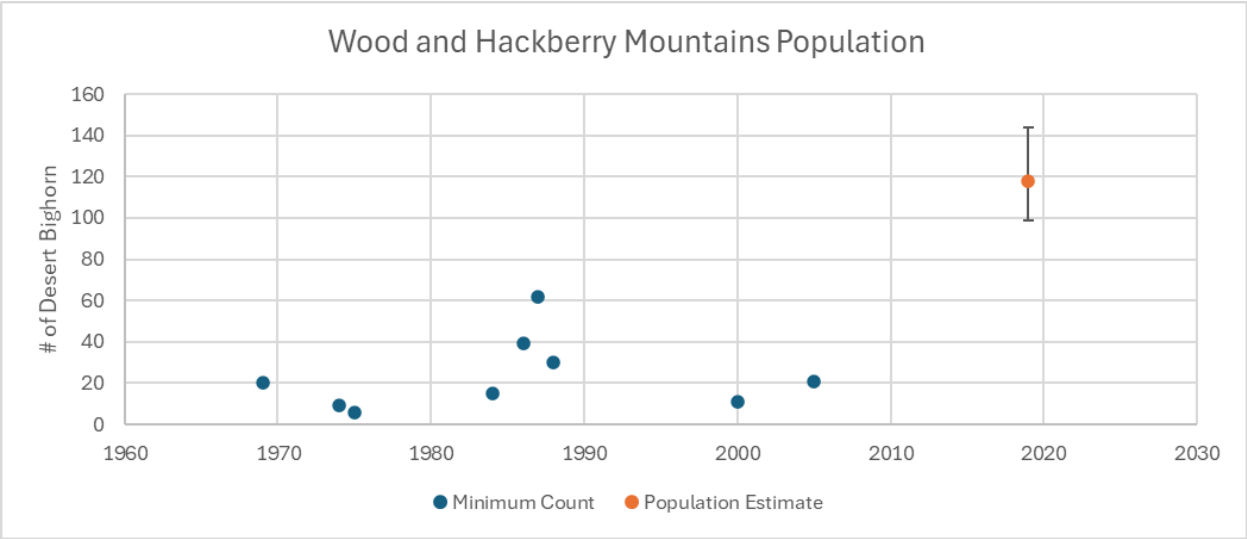

Figure 14. Woods and Hackberry deme estimates and minimum counts through time, as detailed in Table 33.

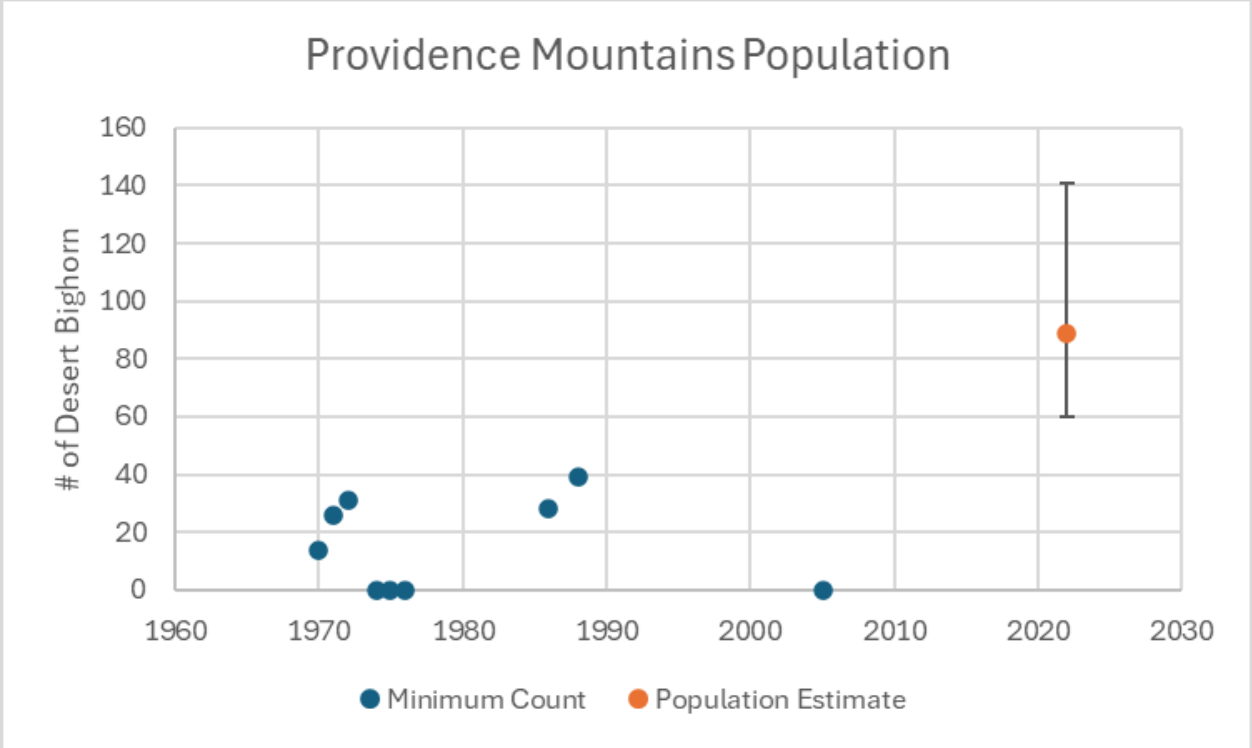

Figure 15. Providence deme estimates and minimum counts through time, as detailed in Table 33.

Management Recommendations:

- Capture and collar desert bighorn as time and staffing allow in in the Woods, Hackberry, and Providence Mountains subpopulation (Action 1.1.2.).
- Conduct biennial ground, camera, and/or helicopter population surveys in Woods, Hackberry, and Providence Mountains subpopulation (Action 1.1.3).

Mortality Factors:

Disease and predation are important factors for the health of the Woods, Hackberry, and Providence subpopulation (Table 34, 34, 35). After the introduction of deer in the 1940s, deer have remained present in these ranges, indicating the potential for an increased mountain lion population and predation risk for bighorn sheep. Since 2013, approximately 15% of investigated mortalities have shown signs of mountain lion predation.

Table 34. Woods, Hackberry, and Providence Mountains subpopulation serology results.

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
WDHK	2013	6	1 / 5	0 / 6 (0%)	0 / 6 (0%)	1 / 6 (17%)	0 / 6 (0%)	0 / 6 (0%)	0 / 6 (0%)	0 / 6 (0%)	2 / 6 (33%)	5 / 6 (83%)	2 / 6 (33%)
WDHK	2014	1	0 / 1	0 / 1 (0%)	0 / 1 (0%)	1 / 1 (100%)	0 / 1 (0%)			0 / 1 (0%)	1 / 1 (100%)	1 / 1 (100%)	0 / 1 (0%)
WDHK	2015	8	1 / 7	0 / 8 (0%)	1 / 7 (14%)	8 / 8 (100%)	0 / 8 (0%)			0 / 8 (0%)	4 / 7 (57%)	8 / 8 (100%)	0 / 8 (0%)
WDHK	2017	2	2 / 0	0 / 2 (0%)	0 / 2 (0%)	2 / 2 (100%)	0 / 2 (0%)	0 / 2 (0%)		0 / 2 (0%)	1 / 1 (100%)	2 / 2 (100%)	0 / 1 (0%)
WDHK	2020	12	4 / 8	0 / 13 (0%)	0 / 13 (0%)	4 / 13 (31%)	0 / 13 (0%)	0 / 13 (0%)		0 / 13 (0%)	6 / 13 (46%)	13 / 13 (100%)	0 / 13 (0%)
PROV	2021	8	3 / 5	0 / 8 (0%)	0 / 8 (0%)	1 / 8 (13%)	0 / 8 (0%)	0 / 8 (0%)		4 / 8 (50%)	2 / 8 (25%)	8 / 8 (100%)	1 / 8 (13%)
PROV	2024	3	1 / 2	0 / 3 (0%)	0 / 3 (0%)		0 / 3 (0%)	0 / 3 (0%)	0 / 3 (0%)	1 / 3 (33%)	3 / 3 (100%)	3 / 3 (100%)	
WDHK	2024	9	4 / 5	0 / 9 (0%)	0 / 9 (0%)		0 / 9 (0%)	0 / 9 (0%)	0 / 9 (0%)	0 / 9 (0%)	8 / 8 (100%)	9 / 9 (100%)	

Serosurveillance is conducted on serum from captured bighorn to assess exposure to common diseases of livestock through antibodies to the following pathogens: Bluetongue Virus (BTV), Epizootic Hemorrhagic Disease Virus (EHDV), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Type 1 & 2 (BVD-1, BVD-2),

Parainfluenza Virus Type-3 (PI-3), Brucella ovis (Bruc), Contagious Ecthyma (CE), Anaplasma sp. (Ana), and Chlamydia sp. (Chla).

Table 3535. Woods, Hackberry, and Providence Mountains *Mycoplasma ovipneumoniae* (*M. ovipneumoniae*) results. Samples are collected from captured bighorn (cap) as well as opportunistically from harvested and dead bighorn (surv).

Deme	Year	N (cap/surv)	Sex (M/F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
WDHK	2013	6 (6/0)	1 / 5	BHS-002 Mojave	3	3 / 5 (60%)	3 / 6 (50%)
WDHK	2014	1 (1/0)	0 / 1		0	0 / 1 (0%)	0 / 1 (0%)
WDHK	2015	8 (8/0)	1 / 7		0	2 / 8 (25%)	2 / 8 (25%)
WDHK	2017	2 (2/0)	2 / 0		0	0 / 2 (0%)	2 / 2 (100%)
WDHK	2018	0 (0/0)	0 / 0		0	0 / 1 (0%)	
WDHK	2020	12 (12/0)	4 / 8	BHS-002 Mojave	1	1 / 14 (7%)	5 / 13 (38%)
PROV	2021	8 (8/0)	3 / 5		0	0 / 8 (0%)	1 / 8 (13%)
PROV	2024	3 (3/0)	1 / 2		0	0 / 3 (0%)	0 / 3 (0%)
WDHK	2024	9 (9/0)	4 / 5		0	0 / 9 (0%)	0 / 9 (0%)

PCR positives are occasionally sequenced to identify the strain circulating in the population. The PCR assay is conducted on nasal swabs and screens for *M. ovipneumoniae*. DNA, suggesting an active infection in the population. The ELISA test screens for antibodies in serum from captured bighorn to *M. ovipneumoniae* and if positive suggests prior exposure to the pathogen.

Table 3636. Woods and Hackberry (WDHK) and Providence (PROV) Mountains selenium results.

Deme	Se PPM (CI95)
PROV	0.32 ,n=11 (0.29, 0.35)
WDHK	0.28 ,n=40 (0.27, 0.3)

Blood Selenium (Se) is occasionally tested from captured bighorn. The results are reported as the average blood/serum concentration for all samples, the number of samples tested and a 95% confidence interval of the mean. Normal Selenium for desert bighorn sheep in California has been shown as 0.09–0.49ppm (Poppenga et al. 2012). Lower selenium levels have been linked to reduced survival perhaps by reducing immune function (Tsuchida et al. 2024).

Translocation History:

As of 2025, there have been no translocations of desert bighorn into or out of this subpopulation and there are no management recommendations involving translocations for this subpopulation.

Public Use:

The Woods, Hackberry, and Providence Mountains subpopulation provides minimal opportunities for viewing desert bighorn, but occasionally, they can be spotted near the Hole in the Wall Campground and Mitchell Caverns.

This subpopulation is proposed as a new hunt zone starting the 2026/2027 season. Connectivity across the mountain ranges has been documented frequently by GPS collared animals. Since 2019, this subpopulation has maintained a ram population suitable for harvest (greater than 7 mature rams). While conducting consistent, high-resolution surveys of this range would be too resource intensive, camera surveys with mark-resight estimates based on natural marks, or minimum counts, combined with occasional helicopter surveys will provide sufficient data for recommending a sustainable harvest in this subpopulation. If the hunt zone is approved by the Fish and Game Commission, harvest from this zone will be conservative and likely be lower proportionally than others, due to coarser resolution population data.

Management Recommendations:

- Use findings from population surveys to provide recommendations for a new hunt zone in this subpopulation (Action 3.1.3.).
- If a new hunt zone is established, continue to conduct population surveys biennially and monitor disease status to inform tag quotas (Actions 3.1.1. and 3.1.2.).

- Coordinate with the MOJA to provide educational materials at the Hole in the Wall kiosk and online (Actions 3.2.1. and 3.2.2.).
- Coordinate with Mitchell Caverns to provide interpretive programs and educational materials at the State Park and online (Actions 3.2.1. and 3.2.2.).

Castle-Piute Subpopulation

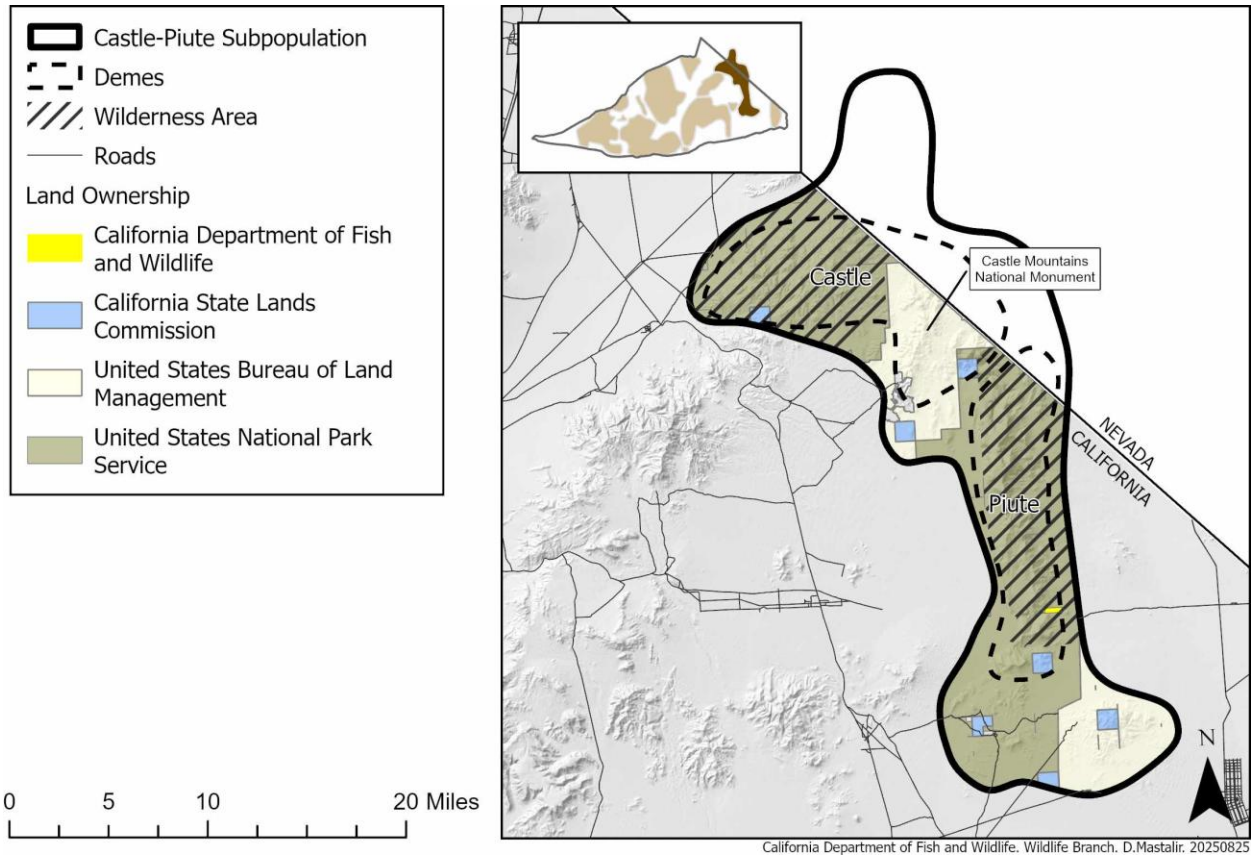

Figure 16. Map of Castle-Piute subpopulation and the Castle and Piute demes.

The Castle Mountains and Piute Range sit along the California-Nevada border north of I-40. The subpopulation is well connected with the Hackberry Mountains to the west and was likely historically connected to the Old Woman Mountains by way of the Piute Mountains, which lay south of I-40 from the Piute Range (Figure 16).

Conservation Concerns:

- Castle Mountain Gold Mine, owned by Equinox Gold, became fully operational in 2020 after being dormant since 2004. As of 2025, the Mine is cooperating with the Department on monitoring and mitigating the impacts of the operation on desert bighorn there. However, long-term monitoring should continue.

Habitat Condition:

The Castle Peaks, while cartographically part of the New York Mountains, join the Castle Mountains as exposed rock features reaching from nearly 4,500 to 6,000 ft of elevation. The Piute Range continues from there south as a flat-top ridge dropping from 4,700 to 3,700 ft to the west, and more precipitously to 2,700 ft to the east, dispersing as it approaches I-40 to a few discrete mountains: The Vontrigger Hills, Billie Mountain, Signal Hill, and Homer Mountain. Diverse vegetation consists commonly of black brush (*Coleogyne ramosissima*) shrubland, Mojave yucca (*Yucca schidigera*) shrubland

throughout, and Joshua Tree Woodland at higher elevations. Water is available to bighorn at three WWDs (Viceroy, Oro Belle, Kidney Spring) in the Castle Mountains and one in the Piute Range (Piute WWD), and at natural springs throughout the ranges, including Piute Spring which forms a perennial creek running almost a mile through the southern end of the Piute Range.

The Castle Mountain gold mine was fully operational between 1991 and 2004, before production stopped due to low gold prices. After initial testing between 2015-2020, Equinox Gold decided to re-open the mine and make the mine fully operational in October 2020. While this operation has altered habitat and reduced available vegetation, bighorn sheep appear to have habituated to some of the activities. Ewes have been observed using man-made cliffs within the mining operation for lambing habitat and two of three WWDs in the Castle Mountains were implemented as mitigation for habitat loss. However, long-term monitoring should continue to reduce deleterious effects on the resident population.

There is overlap with deer, especially in the northern portion of this subpopulation. It is assumed these deer expanded from the population introduced in the Providence Mountains in the 1940s but historic information is limited. There are no known burro populations, however known burro populations to the north along I-15 do pose a potential threat.

Management Recommendations:

- Collaborate with the Nevada Department of Wildlife on connectivity between the Castle Mountains and the McCullough Mountains in Nevada. (Actions 1.3.1. and 1.3.2.).
- Maintain and monitor the Piute WWD (Actions 2.2.4 and 2.2.5). Work with MOJA to evaluate the Piute Range WWD for relocation and redesign to increase functionality and feasibility of monitoring, maintenance, and filling of the system (Action 2.2.8.).
- Work with Castle Mine to monitor, maintain, and ensure consistent water availability at the Orobelle WWD (Actions 2.2.4 and 2.2.5).
- Work with Castle Mine to monitor, maintain, and fill the Viceroy and Kidney Springs WWDs (Actions 2.2.4 and 2.2.5). Modernize the Kidney Spring WWD.
- Monitor Escarpment Spring and Piute Creek for presence of accessible surface water especially during periods of drought (Actions 2.2.1., 2.2.4., 2.2.6.).
- Work with SCBS to install a new WWD on land leased from the California State Lands Commission on Homer Mountain to enhance habitat use and increase connectivity (Actions 1.3.2., 1.3.3. 2.2.8.).
- Work with the NPS and private landowners to monitor burro presence and consider if there are suitable water locations where burro exclusion fencing should be established (Actions 2.4.1.-2.4.3.).

Demographics:

This subpopulation is native and contains 150-200 desert bighorn (Table 37, Figure 17). GPS Collars elucidated two separate ewe demes between the Piute Range and the Castle Mountains, with some Castle Mountain ewes crossing Hart Mine Road into the Castle Peaks. Rams have been observed to range throughout, and as far south as Homer Mountain.

The Castle and Piute Mountains subpopulation has been successfully surveyed by helicopter in a single seven-hour flight day, with sightability of 58% in 2019, and 80% in 2019.

A camera survey was conducted in 2023 with sightability of 70% for ewes, and 60% for rams, however unusually wet conditions may have resulted in lower resight rates for this survey. Cameras were placed at all WWDs, Escarpment Spring, Piute Tinaja (below Piute WWD) and three cameras along Piute Creek.

A ground survey of the range is unlikely because of wilderness access, mine access, and difficult terrain. A fecal-mark-resight survey is not feasible because reaching some of the water sources on foot would be prohibitively dangerous to access in summer months.

Table 37. Castle Piute Mountain subpopulation demographic data ranging from 2018-2025, using a variety of survey methods including helicopter surveys (Heli) and camera surveys.

Deme	Year	Survey Method	Ewe Est	Ewe CI	Ram Est	Ram CI	Lamb/Ewe	Yearling/ Ewe	Ram/Ewe
Castle and Piute	2018	Heli	54*	43-75	25*	21-34	0.21	0.09	0.53***
Castle and Piute	2019	Heli	83**	48-132	20*	14-33	0.38	0.15	0.42***
Castle Only	2021	Camera	110**	60-203	54**	22-130	0.64	0	0.59***
Castle and Piute	2023	Camera	78**	58-105	35**	18-70	0.46	0.23	0.5***
Castle and Piute	2025	Camera	61**	45-77	29**	21-61	0.10	0.07	0.41***

*Simultaneous Double-Count. **Mark-Resight. +Minimum Count. ++Ram/Ewe Ratios from minimum counts and simultaneous double counts reflect availability of rams and ewes for sighting during a survey, may not be representative, and most frequently undercount rams. ***Ram and ewe mark-resight estimates where an entire subpopulation is not surveyed may represent different parts of the subpopulation, leading to inaccuracies.

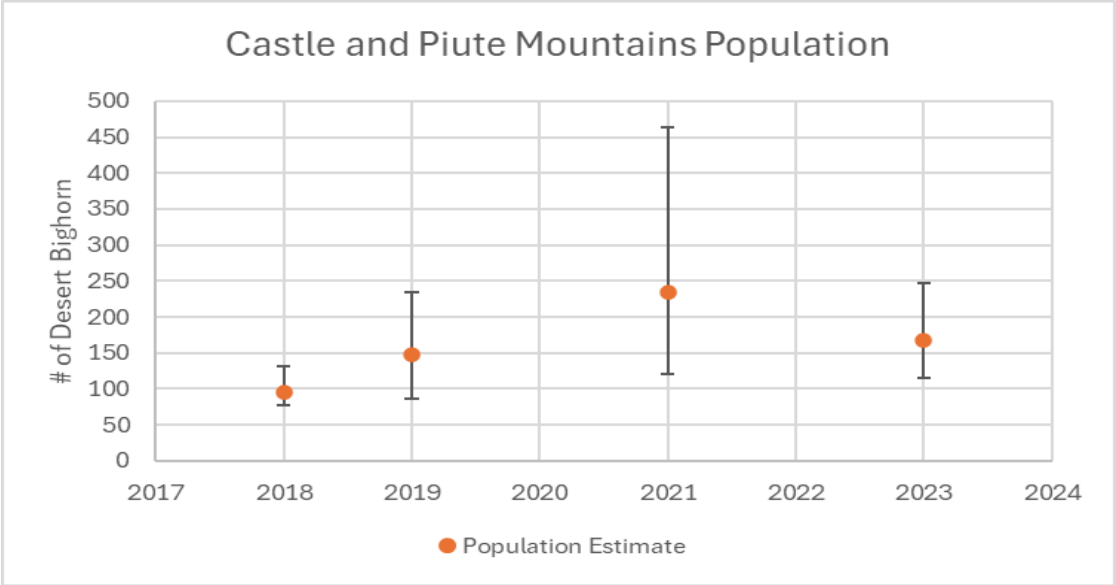

Figure 17. Castle-Piute subpopulation estimates and minimum counts through time, as detailed in Table 37.

Management Recommendations:

- Capture and collar desert bighorn at 4-5-year intervals in the Castle Mountains and Piute Range demes (Action 1.1.2.).
- Collared animals will be monitored for survival and cause specific mortality (Action 1.1.4.).
- Conduct a camera survey with a mark-resight estimate every two years in Castle Mountain deme. Conduct a camera survey with a mark-resight estimate every four years in the Piute Range deme (Action 1.1.3).

Mortality Factors:

The Castle and Piute Mountains subpopulation has been monitored for various pathogens since 2018 (Table 38, Table 39, Table 40). Since collaring of animals in the Castle Mountains in 2018, around 30% of mortalities investigated have shown signs of mountain lion predation. However, annual survival has not fallen below a sustainable level of approximately 90%.

Table 38. The Castle-Piute subpopulation (CMPR) serology results from 2018-2024.

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
CMPR	2018	12	2 / 10	0 / 12 (0%)	0 / 12 (0%)	10 / 12 (83%)	0 / 24 (0%)	0 / 12 (0%)		0 / 12 (0%)	9 / 12 (75%)	11 / 12 (92%)	1 / 12 (8%)

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
CMPR	2020	13	5 / 8	0 / 14 (0%)	0 / 14 (0%)	6 / 14 (43%)	0 / 14 (0%)	0 / 14 (0%)		0 / 14 (0%)	5 / 14 (36%)	14 / 14 (100%)	0 / 14 (0%)
CMPR	2021	4	0 / 4	1 / 4 (25%)	1 / 3 (33%)	2 / 4 (50%)	0 / 4 (0%)	0 / 4 (0%)		0 / 4 (0%)	0 / 4 (0%)	4 / 4 (100%)	0 / 4 (0%)
CMPR	2022	13	0 / 13	0 / 13 (0%)	0 / 13 (0%)	2 / 13 (15%)	0 / 13 (0%)	0 / 13 (0%)	0 / 13 (0%)	0 / 13 (0%)	4 / 13 (31%)	13 / 13 (100%)	1 / 13 (8%)
CMPR	2024	7	5 / 2	0 / 7 (0%)	0 / 7 (0%)		0 / 7 (0%)	0 / 7 (0%)	0 / 7 (0%)	0 / 7 (0%)	5 / 5 (100%)	5 / 7 (71%)	

Serosurveillance is conducted on serum from captured bighorn to assess exposure to common diseases of livestock through antibodies to the following pathogens: Bluetongue Virus (BTV), Epizootic Hemorrhagic Disease Virus (EHDV), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Type 1 & 2 (BVD-1, BVD-2), Parainfluenza Virus Type-3 (PI-3), *Brucella ovis* (Bruc), Contagious Ecthyma (CE), *Anaplasma sp.* (Ana), and *Chlamydia sp.* (Chla).

Table 39. Castle and Piute Mountains *Mycoplasma ovipneumoniae* results. Samples are collected from captured bighorn (cap) as well as opportunistically from harvested and dead bighorn (surv).

Deme	Year	N (cap/ surv)	Sex (M/F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
CMPR	2018	12 (12/0)	2 / 10	BHS-002 Mojave	2	2 / 12 (17%)	4 / 12 (33%)
CMPR	2019	0 (0/0)	0 / 0		0	0 / 3 (0%)	
CMPR	2020	13 (13/0)	5 / 8		0	0 / 14 (0%)	5 / 14 (36%)
CMPR	2021	5 (4/1)	0 / 5	BHS-002 Mojave	1	2 / 6 (33%)	3 / 4 (75%)
CMPR	2022	13 (13/0)	0 / 13		0	0 / 13 (0%)	8 / 13 (62%)
CMPR	2024	7 (7/0)	5 / 2		0	0 / 7 (0%)	1 / 7 (14%)

PCR positives are occasionally sequenced to identify the strain circulating in the population. The PCR assay is conducted on nasal swabs and screens for *M.*

ovipneumoniae. DNA, suggesting an active infection in the population. The ELISA test screens for antibodies in serum from captured bighorn to *M. ovipneumoniae* and if positive suggests prior exposure to the pathogen.

Table 40. Castle and Piute Mountains selenium results.

Deme	Se PPM (CI95)
CMPR	0.29 ,n=50 (0.27, 0.3)

Blood Selenium (Se) is occasionally tested from captured bighorn. The results are reported as the average blood/serum concentration for all samples, the number of samples tested and a 95% confidence interval of the mean. Normal Selenium for desert bighorn sheep in California has been shown as 0.09–0.49ppm (Poppenga et al. 2012). Lower selenium levels have been shown to reduce survival perhaps by reducing immune function (Tsuchida et al. 2024).

Translocation History:

As of 2025, there have been no translocations of desert bighorn into or out of this subpopulation and there are no management recommendations involving translocations for this subpopulation.

Public Use:

The Castle-Piute subpopulation provides limited opportunities for aesthetic, educational, and recreational use of desert bighorn due to remoteness of the range.

The Castle Mountain and Piute Range subpopulation is proposed as a hunt zone. The substantial population and ease of surveying make this subpopulation especially suitable. While the Castle Mountain National Monument (20,920 acres) notably does not allow hunting, it occupies a small enough fragment of this subpopulation that its exclusion is not prohibitive to a potential zone.

Management Recommendations:

- Use findings from population surveys to provide recommendations for a new hunt zone in this subpopulation (Action 3.1.3.).
- If a new hunt zone is established, continue to conduct population surveys and monitor disease status to inform tag quotas (Actions 3.1.1. and 3.1.2.).

Dead Mountains Subpopulation

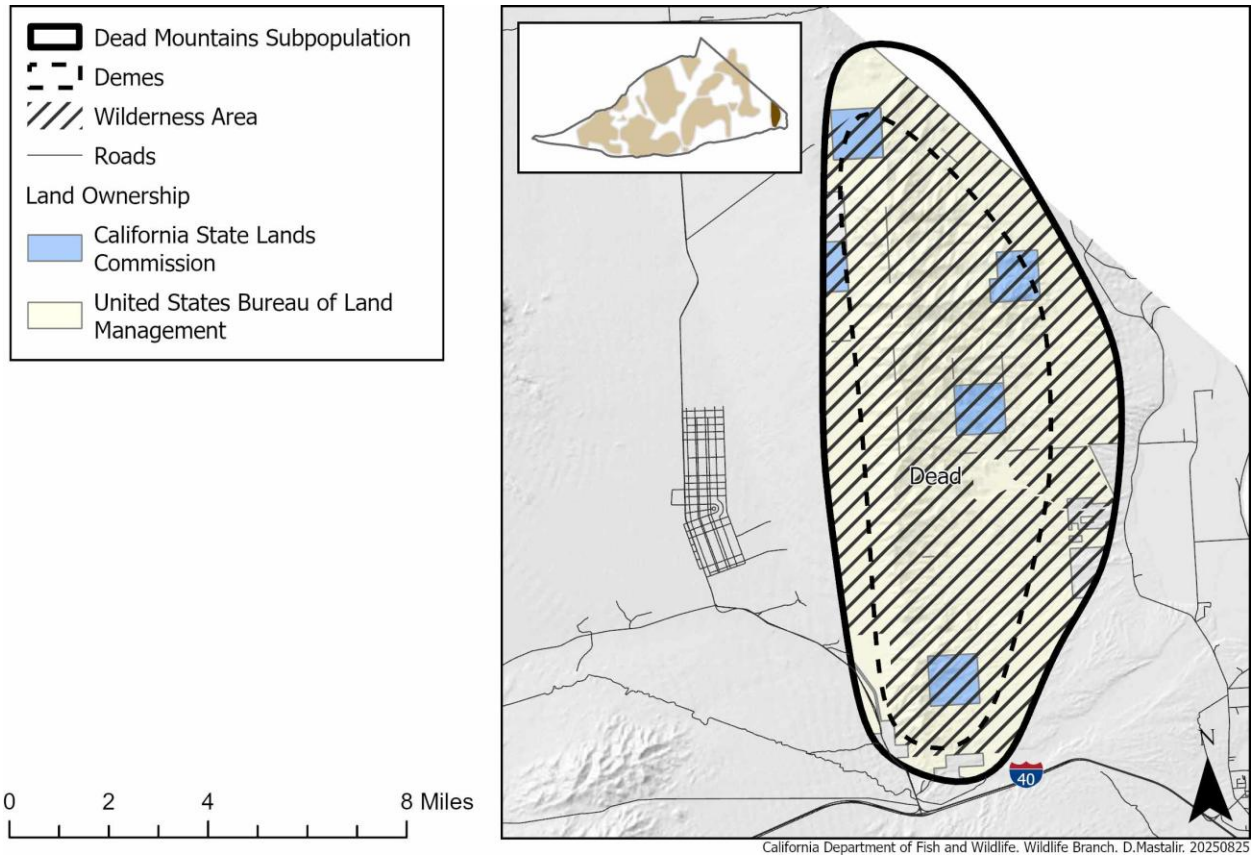

Figure 18. Map of Dead Mountains subpopulation which consists of one deme.

The Dead Mountains is a relatively isolated mountain range on the eastern border of this BCU (Figure 18). They are separated from the Sacramento Mountains to the south by I-40 and from the Piute Range by Piute Valley to the east. One potential exception is a relatively long migration corridor that uses Homer Mountain as a stepping-stone across Highway 95. Across the Nevada border the Dead Mountains are closely connected with the Newberry Mountains, a population of high genetic diversity and high gene flow with the Eldorado Mountains to the north in Nevada (Wehausen 2011).

Conservation Concerns:

- It seems unlikely that the Dead Mountains population will be sustained or restored without an improvement in climatic conditions and the regeneration of natural springs, or the repair and installation of artificial water sources. Due to its' remoteness, and propensity to flash flood damage, the Eagle Feather Tank alone is inadequate to sustain a bighorn population. While natural water sources exist, it is unknown if any of these springs could be considered perennial.
- I-40 separates the Dead Mountains from the Sacramento Mountains to the south, leaving the most likely source of connectivity with the Spirit Mountains of Nevada.

Habitat Condition:

The Dead Mountains cover roughly 50 square miles and range from 3,600 ft of elevation on Mt. Manchester, sloping off to less than 500 ft near the Colorado River. Vegetation largely consists of creosote and wash scrub. One WWD (Eagle Feather Tank) exists in the central part of the range. Over two miles of flat farmland and river alluvium separate the Dead Mountains from the Colorado River, making it perhaps unlikely that this population waters there.

This herd unit is impacted by burros and was classified as extinct for about three decades until desert bighorn were rediscovered there in the 1980s (Wehausen 1999).

Management Recommendations:

- Collaborate with the Nevada Department of Wildlife on connectivity between the Castle Mountains, Nevada, and the greater desert bighorn population of the southwest (Actions 1.3.1. and 1.3.2.).
- Monitor Dead Mountain Adit, Picture Spring, and Lower Picture Spring for water availability and bighorn use (Actions 2.2.4. and 2.2.6.).
- Repair, and replace parts as needed for the Eagle Feather WWD, continue to monitor and maintain (Actions 2.2.4., 2.2.5., 2.2.7.).
- Install one or two new WWDs in the Dead Mountains to provide consistent water sources for bighorn in the Dead Mountains (Actions 1.3.3., 2.2.8.).
- Collaborate with the BLM to evaluate if there are suitable locations where burro exclusion fencing should be established around water sources (Actions 2.4.1.-2.4.3.).
- Use genetic, GPS, telemetry, and observational data, to examine the viability of and potential locations for wildlife overcrossings connecting the Dead Mountains south across I-40 to the Sacramento Mountains (Actions 1.3.1.-1.3.4.).

Demographics:

This subpopulation is considered native but contains fewer than 25 desert bighorn. Given the existing connection with the Newberry Mountains in Nevada, the Dead Mountains may be part of a southern Nevada subpopulation that contributes little to metapopulation processes in California, though historically may have been more connected to population in the south central BCU through the Sacramento Mountains.

In 2019, a total of 12 desert bighorn were observed by helicopter while in 1989 a total of 30 desert bighorn were observed. In November of 2021, two adult ewes and one male lamb were captured from the Dead Mountains. Both ewes died in January of 2022, however mortality investigations were unconclusive. Forage was observed to be poor during this period, and four carcasses suspected to be less than one year old were found near the dry Dead Mountain Adit. Picture Canyon Spring, where bighorn use has been documented by indigenous people, was also observed to be dry, and in the early 2000s, the Eagle Feather Tank became defunct. It may be that a loss of water sources, poor forage, and other factors have led to a recent decline in this population. It’s also

possible that the population declined earlier, and the remaining bighorn are a remnant population, migrated from Nevada, or both.

A helicopter survey of the Dead Mountains was conducted in 2019 (Table 41). Because of low overall numbers, no sightability estimate was available. The survey took less than a seven-hour flight day. A ground survey of the Dead Mountains would be unreasonable due to rugged terrain. The two desert bighorn collared in 2021 did not survive long enough to provide GPS locations of point water sources. It's possible that perennial water sources are not currently present in the range. Therefore, a camera or fecal-mark-recapture survey is not possible in the range.

Table 41. Dead Mountains subpopulation demographic data (minimum count) from a 2019 helicopter survey.

Survey Type	Year	Adult Ewes	Adult Rams	Yearling Rams	Lambs	Total Min Count
Helicopter	2019	7	3	1	1	12

Management Recommendations:

- Capture and collar desert bighorn as funding and staffing allow in the Dead Mountains subpopulation (Action 1.1.2.).
- Conduct a ground, camera, and/or helicopter population or occupancy survey in Dead Mountains subpopulation as funding and staffing allow (Action 1.1.3).

Mortality Factors:

As of 2025, there have been no successful cause-specific mortality investigations, the only data we have is from the 2021 capture effort (Table 42, Table 43, Table 44).

Table 42. The Dead Mountains serology results from the 2021 capture effort.

Deme	Year	n	Sex (M/F)	BTV	EHDV	BRSV	BVD-1	BVD-2	*Bruc*	PI-3	CE	*Ana*	*Chla*
DEAD	2021	3	1 / 2	1 / 3 (33%)	1 / 2 (50%)	1 / 3 (33%)	0 / 3 (0%)	0 / 3 (0%)		1 / 3 (33%)	1 / 3 (33%)	0 / 3 (0%)	0 / 3 (0%)

Serosurveillance is conducted on serum from captured bighorn to assess exposure to common diseases of livestock through antibodies to the following pathogens: Bluetongue Virus (BTV), Epizootic Hemorrhagic Disease Virus (EHDV), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Type 1 & 2 (BVD-1, BVD-2),

Parainfluenza Virus Type-3 (PI-3), *Brucella ovis* (Bruc), Contagious Ecthyma (CE), *Anaplasma sp. (Ana)*, and *Chlamydia sp.* (Chla).

Table 43. The Dead Mountains *Mycoplasma ovipneumoniae* results.

Deme	Year	N (cap/ surv)	Sex (M/F)	*M. ovipneumoniae* Strain Detected	# PCR+ Sequenced	*M. ovipneumoniae - PCR*	*M. ovipneumoniae - ELISA*
DEAD	2021	3 (3/0)	1 / 2		0	0 / 3 (0%)	1 / 3 (33%)

Samples are collected from captured bighorn (cap) as well as opportunistically from harvested and dead bighorn (surv). PCR positives are occasionally sequenced to identify the strain circulating in the population. The PCR assay is conducted on nasal swabs and screens for *M. ovipneumoniae*. DNA, suggesting an active infection in the population. The ELISA test screens for antibodies in serum from captured bighorn to *M. ovipneumoniae* and if positive suggests prior exposure to the pathogen.

Table 44. Dead Mountains selenium results from 2021.

Deme	Se PPM (CI95)
DEAD	0.31 ,n=3 (0.28, 0.33)

Blood Selenium (Se) is occasionally tested from captured bighorn. The results are reported as the average blood/serum concentration for all samples, the number of samples tested and a 95% confidence interval of the mean. Normal Selenium for desert bighorn sheep in California has been shown as 0.09–0.49ppm (Poppenga et al. 2012). Lower selenium levels have been shown to reduce survival perhaps by reducing immune function (Tsuchida et al. 2024).

Translocation History:

As of 2025, there have been no translocations of desert bighorn into or out of this subpopulation and there are no plans involving translocations for this subpopulation.

Public Use:

The Dead Mountain subpopulation provides limited opportunities for aesthetic, educational, or recreational use of desert bighorn.

Mescal Range and Ivanpah Mountains

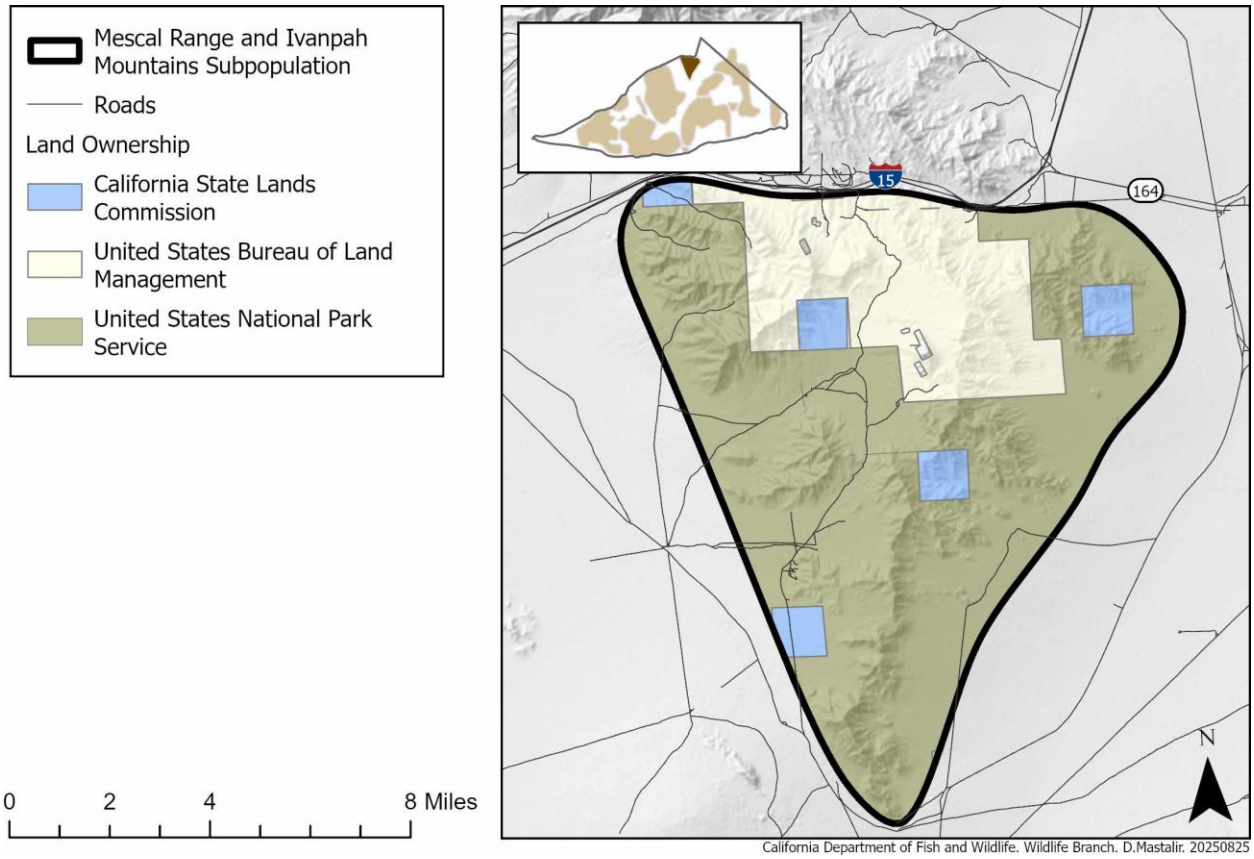

Figure 19 Map of the Mescal Range and Ivanpah Mountains, a historically inhabited area. As of 2025, there is no known use of this area by desert bighorn.

Located south of I-15 and west of the Nevada border, the connected Mescal and Ivanpah mountain ranges are included in this plan as unoccupied habitat (Figure 19). There is historic evidence of bighorn sheep use, but the Department has no evidence that this location has supported bighorn sheep over the past forty years. Preliminary DNA analysis of fecal samples collected in 2019 by Oregon State University indicated the presence of desert mule deer, but no bighorn sheep. As noted above, the desert bighorn that used these ranges were most likely part of the Clark Mountain deme prior to the construction of I-15 in the 1960s. With I-15 as a barrier to the north, the Mescal Range and Ivanpah Mountains are isolated from other ranges inhabited by desert bighorn and as a result are a low priority for management actions. However, if connectivity from Clark Mountain is established, then the status of this herd unit would be an important stepping-stone habitat for gene flow from Clark Mountain to the Castle Mountain, Providence Mountain, and Indian Springs demes.

Conservation Concerns:

- The Mescal Range and Ivanpah Mountains subpopulation provides a potential key-corridor across I-15 between the Clark Mountain subpopulation and the

NCDBCU. Restoration of this corridor would require a wildlife overcrossing and subsequent colonization of the Mescal and Ivanpah Mountains by desert bighorn.
- Burros are present in the Mescal Mountains. Any colonization of this area by desert bighorn should be monitored along with burro presence and activities, particularly at water sources.

Habitat Condition:

These ranges cover roughly 60 square miles, ranging from 3,000 ft of elevation along the eastern edge, to 6,499 ft on top of Mescal Mountain. Habitats include creosote bush scrub, Joshua tree woodland, and pinyon-juniper forest. Water is present and utilized by mule deer on the north side of the Mezcal Range, and in the exposed pit of the inactive Morningstar Mine.

Feral burros are present on the west side and likely exist throughout the range. As of 2025, MOJA estimates a population of 50 burros, with roughly 100 more in Clark Mountain, north of I-15.

Given the availability of surface water, and the abundance of suitable escape terrain throughout, it's possible that a permanent or transitory bighorn population could establish via migration if a wildlife corridor were built between Clark Mountain and the Mezcal Mountains. Within the range, residential developments at the north end of the Mezcal Mountains utilize and affect some springs.

Management Recommendations:

- Work with Caltrans to construct a wildlife overcrossing connecting the Mezcal Mountains north across I-15 to Clark Mountain (Actions 1.3.3. and 1.3.4.).
- Monitor water availability and bighorn use at Hardrock Queen Spring and the Morningstar Mine (Actions 1.3.5. and 2.2.6.).
- Conduct vegetation sampling within this range to understand how desert bighorn returning to the landscape changes the ecosystem.
- Work with MOJA and private landowners to monitor for burro presence and consider if there are suitable water locations where burro exclusion fencing should be established (Actions 2.4.1.-2.4.3.).

Demographics:

Desert bighorn do not currently inhabit this range. The range was historically utilized by desert bighorn before the construction of I-15 and mining developments at Mountain Pass, which left the range isolated, over 12 miles away from the next closest bighorn population, Club Peak and Indian Springs, which lies to the west.

After construction of an overpass, cameras on the overpass will monitor for colonization. GPS collared desert bighorn may demonstrate potential for use of point water sources such as Hardrock Queen Spring or Morningstar Mine. A helicopter survey of the range would also be feasible in a single seven-hour flight day.

Management Recommendations:

- Conduct a ground, camera, and/or occupancy survey in Ivanpah and Mescal Mountains subpopulation as time and staffing allow (Action 1.3.5.)

Mortality Factors:

Given the presence of mule deer, if desert bighorn did occupy the range, incidences of mountain lion predation could be expected.

Translocation History:

As of 2025, there have been no translocations of desert bighorn into or out of this subpopulation. In conjunction with or following the construction of a wildlife overcrossing, the translocation of animals to help establish a subpopulation in the Mezcal and Ivanpah Mountains may be considered.

Public Use:

The Mescal Range and Ivanpah Mountains subpopulation provides no known opportunities for aesthetic, educational, and recreational use of desert bighorn, because desert bighorn are not currently present.

New York Mountains

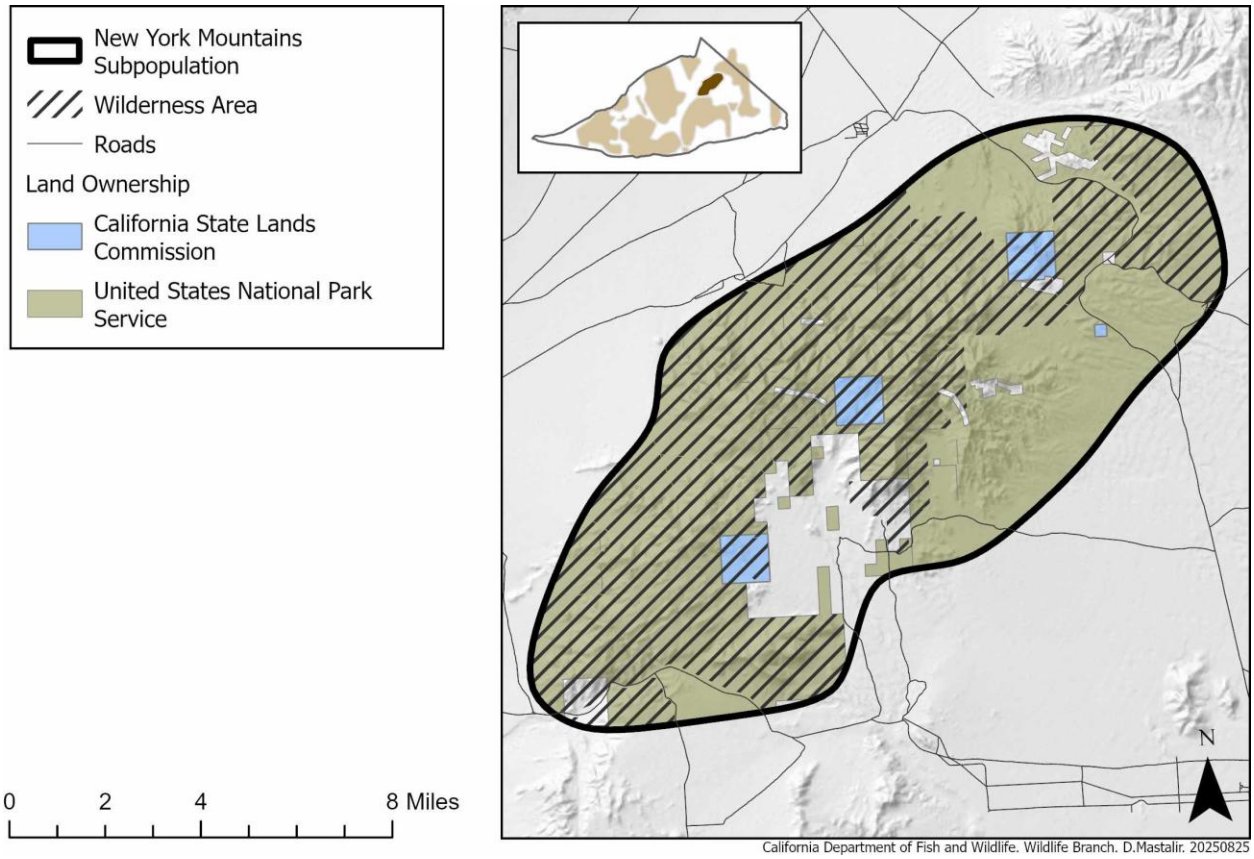

Figure 20 Map of the New York Mountains potential subpopulation. As of 2025, there is no known established population of desert bighorn.

Located in the north-eastern portion of the BCU, the New York Mountains has long-been listed as desert bighorn habitat (Figure 20). However, the Department possesses no evidence that it has ever supported a reproducing population. Instead, it appears to serve as important connecting habitat that rams use in moving between the Castle Peaks and Castle Mountains to the east, the Providence Mountains to the south, and Marl Mountains to the west.

The York fire burned much of the New York Mountains in July and August 2023. This change in vegetation structure could improve desert bighorn habitat and promote desert bighorn use of the mountain range.

Conservation Concerns:

- While desert bighorn are not known to reside within the New York Mountains, protection of this range remains important to maintain connectivity.
- Proposed ground water pumping projects from the Fenner Wash and Orange Blossom Wash watersheds may affect the underground aquifers and therefore springs in the Woods, Hackberry, and Providence Mountains.

Habitat Condition:

The New York Mountains cover approximately 60 square miles ranging in elevation from 3,800 to 7,463 ft. They are characterized by tall vegetation and pinyon-oak-juniper woodland that constitutes relatively poor habitat for bighorn sheep. This excludes the Castle Peaks section of the New York Mountains, which are grouped with the Castle Mountains because of similar habitat type and usage by bighorn sheep. Surface water is available as natural springs.

One WWD has been established on private land in the New York Mountains. The current status of this system is functional, but past records do not indicate bighorn sheep use.

Management Recommendations:

- Work with SCBS to maintain the West 40 and Nichols WWDs and monitor for any sign of bighorn use (Actions 1.3.3., 1.3.5., 2.2.5.).
- Provide comments and analysis on the proposed ground water pumping projects detailing potential impacts on desert bighorn habitat (Action 1.3.3).

Demographics:

There is no known population of bighorn sheep in the New York Mountains. Occupancy surveys may be conducted to monitor the status of bighorn in this range.

Management Recommendations:

- Conduct a ground, camera, and/or occupancy survey in New York Mountains subpopulation as funding and staffing allow (Action 1.3.5.).

Mortality Factors:

Given the presence of mule deer, if desert bighorn did occupy the range, incidences of mountain lion predation could be expected.

Translocation History:

As of 2025, there have been no translocations of desert bighorn into or out of this subpopulation. This mountain range is not currently identified as a potential candidate for translocation.

Public Use:

The New York Mountains provide no known opportunities for aesthetic, educational, and recreational use of desert bighorn.

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