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"We're Going to Tear up the Caldera So We Can Have an Electric Car": Competing Perceptions and Spatial Dimensions of Open-Pit Lithium Mining in the McDermitt Caldera, Oregon

Elizabeth Bartholomew
Portland State University

“We're Going To Tear Up the Caldera so We Can Have an Electric Car”: Competing Perceptions and Spatial Dimensions of Open-Pit Lithium Mining in the McDermitt Caldera, Oregon

by

Elizabeth Bartholomew

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Thesis Committee:
Alida Cantor, Chair
David Banis
Martin Lafrenz
Kate Berry

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Abstract

As the world attempts to pivot away from fossil fuels and other greenhouse gas-emitting activities that fuel climate change, the proposed technological solutions all require raw materials, resources, and land; each of which have their own logistical and political dimensions. Lithium, a federally recognized critical mineral that is considered a crucial element in modern battery production, plays a vital role in decarbonizing efforts. Under the banners of national security, resource independence, and carbon mitigation goals, the United States has incentivized domestic lithium extraction, expediting exploration throughout the American West. The McDermitt Caldera, spanning from southeastern Oregon into northern Nevada, is believed to hold the largest lithium deposit in the United States. Actions have been swift to begin extraction in Nevada's section of the Caldera. The construction of the Thacker Pass open-pit mine began in the spring of 2023, despite legal opposition from pan-Indigenous groups, ranchers, and environmental groups. Across the border in Oregon, mining claims are scattered throughout the Caldera and exploratory drilling has begun. Given the early stage and rapid progression of these mining activities, there is a small but growing body of research regarding lithium mining in the McDermitt Caldera. I build upon this research with a focus on Oregon's section of the Caldera by investigating the social and spatial dimensions of these extractive ambitions. Through the lens of political ecology, I investigate the narratives of opposition or support for potential lithium mining in the state of Oregon, finding that these discourses are backed by anthropocentric or biocentric values that have competing beliefs about the utility of a landscape. Additionally, I analyze the footprints of potential mining

operations with the habitats of state-recognized sensitive species within the Northern Basin and Range ecoregion, where the McDermitt Caldera is located. In this spatial analysis, the habitats of 75% of sensitive species overlapped with mining operations, which aligns with critiques that many renewable energy projects can be harmful to local biodiversity. By integrating the social and spatial components of this study, I contribute to critical scholarship of renewable energy technologies, underlining the complexities and considerations that accompany their implementation. Moreover, I shed light on a region amid a substantial landscape transformation in the name of clean energy, highlighting the perceived trade-offs that are associated with contemporary approaches to energy transitions.

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Table of Contents

List of Tables

List of Figures

1. Introduction

Shifts in global temperature caused by anthropogenic climate change have brought the need for new technologies and energy transitions to the forefront. As society attempts to transition from fossil fuels and other greenhouse gas-emitting activities, novel renewable energy technologies and their associated infrastructures are growing, each possessing demands for raw materials, resources, and land (Knuth et al., 2022; Turley et al., 2022). One element at the top of the list in this transition is lithium, a critical mineral that is a key ingredient in modern battery production used for energy storage.

The push for extraction accompanies the demand for lithium as global production continues to evolve. In the United States, government-backed initiatives like the Inflation Reduction Act have supported this process, incentivizing domestic lithium exploration in the name of meeting climate goals and resource independence. These extractive initiatives have raised concerns of shortsighted ambitions obscuring the long-term environmental consequences and the associated burdens to nearby communities. Extractive histories, especially in the mining sector, have left legacies of socio-environmental exploitation, degradation, and opposition (Bridge, 2004; Conde, 2017; Díaz Paz et al., 2023; Kemp et al., 2010; Mudd, 2008). Lithium mining is no exception. Extraction of lithium is a land and water-intensive process that has raised environmental justice concerns within spaces of extraction. Productive technologies and expedited initiatives have ushered in a new frontier of lithium harvesting to meet the moment, with novel extractive practices broadening the boundaries of prospective mining locations throughout the American West. As lithium extraction increases to serve a budding global demand, there are many unknowns about the long-term consequences of the process. Research is limited yet significant on the environmental and social effects brought by this industry. Many studies have focused on the 'lithium triangle' in South America, where the arid salt pans of Chile, Argentina, and Bolivia have been reconstructed into zones of high-intensity lithium harvesting (Blair et al., 2022; Bustos-Gallardo 2021; Díaz Paz et al., 2023; Dorn et al., 2022).

In the United States, the country's largest suspected lithium deposit lies below the McDermitt Caldera, extending from southern Oregon to northern Nevada. In Nevada's portion of the deposit, the prospective Thacker Pass mine has made continual advances to break ground despite legal opposition from environmental non-profits, local ranchers, and pan-Indigenous groups, concerned with the cultural and environmental threats that accompany the mine. Mine construction began in 2023, the logistics of which include a 2.3 mile-wide open-pit mine and an on-site sulfuric acid facility used for ore separation. Locally, there has been much scrutiny regarding the lack of transparency, limited community engagement, and accelerated Environmental Impact Assessment (Kapoor, 2021).

Across from Nevada's border, southeast Oregon's Malheur County hosts the northern reach of the McDermitt deposit. Several mining companies have staked and claimed land within this section of the Caldera. HiTech minerals, a subsidiary of Australian company Jindalee Lithium (formerly Jindalee Resources Ltd.) is the furthest along in the process, possessing the only permit to explore lithium in Oregon's section of the Caldera. After several phases of exploratory drilling, HiTech claims to hold the largest and most profitable deposit of lithium in North America (Washbourne, 2024).

Mining operations often tout community benefits to territories of extraction, including economic growth, job creation, and infrastructural developments (Aryee, 2001; Nguyen et al., 2017; Slattery et al., 2023). Malheur County, with the highest poverty rate and lowest per capita income in the state (U.S. Census Bureau, 2022), is a region that stands to gain significantly through expansion of its local economy. This invites nuance regarding the benefits and burdens associated with hosting a mine. Across the United States, rural areas have often served as hotspots for extractive industries, giving rise to boom-and-bust economic cycles that can significantly impact local communities in both positive and negative ways. Moreover, the environmental toll incurred by mines can leave behind long-term damage for short-term gains, affecting local water supplies, ecology, and biodiversity.

There exists a tension between the urgency for a decarbonized future and the environmental costs associated with the technologies that can provide it. The mining industry often finds itself in the crosshairs of environmental justice issues, yet the use of extracted materials is deeply ingrained in global society and remains constant. In the near future, Oregon may host multiple lithium mining operations in its southeast corner, ushering in large-scale landscape transformations that have a ripple effect of cultural, environmental, and political implications.

The act of transitioning from carbon-intensive technologies into more sustainable systems is a deeply geographical process (Bridge et al., 2013; Knuth et al., 2022). Under the analytical framework of political ecology, this study employs a place-based, case-study approach to investigate a landscape on the verge of change. Using mixed methods, I investigate social perceptions of potential open-pit lithium mining in Oregon's section of the McDermitt Caldera, in addition to the spatial dimensions of potential mining operations on habitats of sensitive species within the state. The goal of this research is to explore the complexities of energy transitions, investigating a single critical mineral extracted from one location. Moreover, this research aims to inform local policy and environmental management in Oregon's lithium mining operations by illuminating the social, environmental, and political dimensions of lithium mining in the McDermitt Caldera, Oregon.

2. Literature Review

This study employs a political ecology approach to examine how social, political, and economic dynamics influence the environment, alongside the spatial and social dimensions of these transformations. It is further informed by critical analyses of renewable energy technologies and the pursuit of a just energy transition. More specifically, this literature review situates lithium extraction by examining its context within the global economy and reviewing previous studies surrounding the spatial, environmental, and social aspects of lithium extraction. It is through the integration of these analytical frameworks that this research contributes to growing discourse surrounding energy transitions, offering new insights on the socio-environmental dimensions of lithium extraction, particularly within the context of Oregon's budding energy landscape.

2.1 Political Ecology

Political ecology (PE) investigates nature-society relations, underscoring the interconnectivity between political and environmental systems. Interconnectivity is demonstrated through mutually constituted social and environmental ecosystems that shape and are shaped by both biophysical and political forces (Jenkins, 2016; Loftus, 2009; Robbins, 2012; Rocheleau, 2008; Swyngedouw, 2009; Walker, 1998). Forsyth (2002) asserts that the environmental and political processes are "mutually embedded" (p. 266) and warrant a critical approach to sufficiently understand the ecological, social, and political layers present.

A PE framework is not seen as a singular discipline or set of methods, but an interdisciplinary approach that Robbins (2012) describes as a lens that enables one to view "…ecological systems as power-laden rather than politically inert" (p. 13). It is within this framework that PE practitioners examine power imbalances, hidden costs, and the distribution of benefits and burdens within the production of social and environmental outcomes (Bryant & Bailey, 1997; Robbins, 2012). Blaikie and Brookfield (1987), often cited as the originators of PE, advocate for interdisciplinary research that uncovers not just physical changes to landscapes but also the social dynamics driving those changes. Early studies within political ecology reveal the connections between environmental degradation, societal conflicts, and the interplay of power. Blaikie (1985) provides a compelling case by associating colonial legacies, power imbalances, resource exploitation, and market dynamics with soil erosion in developing nations. More recent PE scholarship, such as Curley (2021), advances these discussions by arguing that our very understanding of natural resources is shaped by the colonial enterprise, described as a "violent project of world making" (p. 86).

Resource extraction is a major focus within this field, as it fuses political economy with environmental change, and traditionally benefits those who experience its burdens the least (Himley et al., 2021; Richardson & Weszkalnys, 2014; Robbins, 2012; Voskoboynik & Andreucci, 2022). Many PE studies focus on the exploitation of natural resources and the conflicts that follow. This is because the use, management, and transformation of the environment reflects uneven power distributions between groups, which inevitably leads to dispute (Duffy, 2018; Le Billon, 2015). Swyngedouw (2009) underscores this tension by noting that "…processes of socio-environmental change are never socially or ecologically neutral" (p. 57). Scholars have explored resource struggles in a variety of ways, including the environmental, social, and cultural impacts experienced by frontline communities within spaces of extraction (Gonzalez, 2021; Kirsch, 2014; Díaz Paz et al., 2023) and the knowledge politics and legal frameworks that shape the decision-making processes around natural resource management (Benson, 2012; Birkenholtz, 2008; Owen et al., 2019; Van der Molen, 2018). Previous research has examined how extractive activities can create diverging environmental imaginaries among stakeholders regarding perceptions of place, change, power dynamics, and future implications within these actions (Jenkins, 2018; Kojola, 2020; Mansfield et al., 2018; Saleth & Varov, 2023). For example, Jenkins (2016) uses a case study approach to examine stakeholder reactions to extractive activities in select locations within the American West, revealing that oppositional narratives focused largely on biocentric conservation values and anthropocentric utility of the land. While both narratives align with the goal of opposing extraction, they have the potential to conflict with one another, underscoring the competing ideas and imaginaries surrounding land use.

2.2 Just Energy Transitions

Anthropogenic climate change, driven by elevated greenhouse gas emissions, has profoundly impacted human and environmental systems. Decarbonizing to mitigate these effects requires a deep shift from traditional methods of energy production into renewable energy technologies, whose components and infrastructures require high amounts of raw materials, resources, and land (Knuth et al., 2022; Turley et al., 2022). As efforts increase to pivot towards "clean and green" low-carbon technologies that will facilitate this transition, there has been growing criticism surrounding issues of environmental injustice, dispossession, and environmental degradation. Moreover, many existing and proposed commercial scale renewable energy projects are on or directly adjacent to Indigenous communities, leading to criticisms that the methods employed within green energy transitions are simply a reproduction of colonial systems of resource management (Cantor et al., 2023; Sánchez Contreras et al., 2023; Sankaran et al., 2022).

The concept of just transitions is rooted in activism and labor unions from the early 1970s, with scholarship increasing in the early 2000s as the concept of just energy transitions has evolved. This has united the fields of climate, energy, and environmental justice (McCauley & Heffron, 2018; Wang & Lo, 2021). Under the framework of just energy transitions, a low carbon transition holds parity with social equity in the pursuit of a genuinely sustainable future. Scholars have emphasized the importance of investigating social, political-economic, and environmental systems undergoing transformations under the banner of sustainable energy. This is because the distribution of benefits and burdens may deepen existing social inequalities and give rise to new forms of injustice (Carley & Konisky, 2020; Sovacool et al., 2019).

Previous studies have shown how renewable energy technologies can pose risks to social, environmental, and cultural landscapes due to their land, raw material, and resource requirements. Infrastructure and extractive activities are often located in remote areas rich in biodiversity and cultural significance (Apostol et al., 2017; Gasparatos et al., 2017; Sánchez Contreras et al., 2023; Serrano et al., 2020). Research surrounding the impacts of these proposed or implemented activities have been varied in their approach but identify key environmental justice issues. For example, Lauer et al. (2023) found that the extensive footprint of a proposed solar energy plant in the Mojave desert overlapped with several endemic plant species, fragmented habitat for the federally threatened desert tortoise (*Gopherus agassizii*), and would lead to the removal of over 4,500 Joshua trees (*Yucca brevifolia*). Additionally, risks of soil degradation and erosion from the operation had the potential to threaten air quality for nearby communities, who would not receive any of the energy acquired from the solar energy plant. Cantor et al., (2023) explore tensions with the proposed pumped hydropower storage facility outside of Goldendale, Washington. Opposition is largely led by the Yakama Nation, who are concerned with the operation's impacts to sacred sites, traditional foods, and Tribal cultural resources. Proponents of the operation contend that the storage facility will create jobs, improve the local economy, and support the state of Washington's climate goals. Serrano et al. (2020) examine mortality rates for bird and bat species within Spain's existing 20,000 wind turbines. The authors point out that species protection is compromised by weak governmental regulation and unreliable mortality statistics, which are predominantly self-reported by the wind energy sector. Together, this growing body of literature cautions against uncritical technological optimism and calls for more careful consideration of socio-environmental impacts of "green" technologies.

Zografos & Robbins (2020) caution that places and communities involved within the development and implementation of low-carbon, renewable energy technologies are at risk of becoming "green sacrifice zones." Through the lens of just transition scholarship, researchers aim to pinpoint and influence policies and practices towards achieving a genuinely sustainable future. In this context, a just energy transition is seen as an endeavor of both climate justice and social justice, emphasizing the importance of equity and inclusion in the shift towards a low-carbon society (Newell & Mulvaney, 2013; Sovacool et al., 2019; Stephens, 2019).

2.3 Lithium

Within renewable energy transitions, lithium (Li) has gained increasing importance. Lithium has almost half the density of water and is the lightest of all metals on the periodic table. It has a variety of uses, including ceramics, glassware, psychiatric pharmaceuticals, and—key to green energy transitions—it is a key ingredient for batteries used to store energy (Bustos-Gallardo et al., 2021; Díaz Paz et al., 2023; U.S. Geological Survey, 2014). Lithium-ion batteries are energy-dense and compact, ideal for portable electronic devices including mobile phones, laptops, and cameras. Given its utility and importance, lithium was designated a critical mineral by the U.S. Department of the Interior in 2018.

The shift away from fossil fuel-powered vehicles has significantly increased the importance of lithium, as it is key to replacing fossil fuel-powered internal combustion engines with battery-powered electric motors. The electric vehicle (EV) industry continues to grow, dramatically increasing the demand for lithium (Agusdinata et al., 2018; Uji et al., 2023). Global lithium production has quadrupled between 2010 and 2021 (World Economic Forum, 2023) and is projected to continue growing at a rapid rate. Government-backed initiatives have prioritized EV production, examples include the state of California's pledge to have 1.5 million zero-emission vehicles on the road by 2025 (California Energy Commission, 2023) and President Biden's executive order to transition all federal fleet vehicles to EVs by 2035 (Thompson, 2022). The push for extraction accompanies the demand for lithium. In 2022, the Inflation Reduction Act (IRA) was signed into law, offering tax incentives for EV materials produced domestically, aiming to achieve climate objectives and resource independence (Trost et al., 2023). The IRA outlines that by 2024, 40% of all critical minerals found in EVs must be extracted or processed within the U.S. or countries that share free trade agreements. By 2026, this number rises to 80% (Broughel, 2022). Due to these measures, domestic production is expected to grow substantially in the coming years (S&P Global, 2023).

Lithium deposits are mined via hard rock pegmatites, sedimentary-clays, and liquid brine extraction. Brine extraction occurs in arid salt flats, where saline groundwater is pumped and transported to shallow holding pools to expedite evaporation, leaving behind the concentrated lithium (Bustos-Gallardo et al., 2021; Dorn & Ruiz Peyré, 2020; Kaunda, 2020). Open-pit mining of pegmatites and sedimentary clays removes orebodies from the ground which then undergo various stages of processing to separate the lithium from its host rock (Desjardins, 2015; Kaunda, 2020; Lithium Americas, 2022). Australia, Chile, and China were the largest producers of lithium in 2022 (Garside, 2023). Currently, the only operational lithium mine in the United States is the Silver Peak mine in Silver Peak, Nevada, which uses brine extraction methods. Additional methods such as direct lithium extraction (DLE) from geothermal brine are being developed, as well.

Research surrounding lithium extraction's excessive water use in the hyper-arid salt flats of Chile has shown changes to local flora, fauna, and human communities. Ecological responses do not always present themselves immediately, however, alterations to the biophysical landscape can trigger disruptions and imbalances across varying scales within an ecosystem. Gutiérrez et al. (2022) found that increased groundwater use from nearby lithium operations correlated with decreased wetland habitat, modified lake water chemistry, and species decline of local flamingo communities. Similarly, Liu et al. (2019) examined the link between lithium extraction and environmental degradation, evidenced by a reduction in soil moisture that resulted in declining vegetation. Notably, the research identified a significant die-off of drought-tolerant flora in the immediate area. Blair et al. (2022) examined how communities in the San Pedro and Vilama subbasins faced socioeconomic and cultural displacement when irrigation limitations from diminished water supplies (attributed to nearby mining activities) resulted in reduced crop production, which led to an official request for a Declaration of Exhaustion to prevent additional water allocations.

As global lithium exploration expands, research into the potential impacts, uncertainties, and perceptions related to mining operations is also growing. Parker et al. (2022) applied GIS mapping to delineate the spatial extent of lithium mining sites in select areas of the United States and their overlap with natural habitats, identifying the species inhabiting these areas and discussing the potential impacts of these mining projects on local biodiversity. Regarding perceptions from frontline communities, Slattery et al. (2023) found that community members near potential mining operations in the Imperial Valley, California, were concerned with water use, impacts to the local ecology, public health, and employment opportunities. These apprehensions are echoed in the work of Kingsbury & Wilkinson (2023), who interviewed a spectrum of stakeholders within the northern region of Québec, Canada, regarding the impending Authier lithium mine. Although certain community members raised concern about environmental issues associated with mining operations, they also recognized that mining was embedded within the region's identity and believed it was essential for its economic future. This research reveals the complexities, imaginaries, and unknowns involved in potential extractive activities for the purpose of a low-carbon energy future.

2.4 Synthesis and Gaps

There has been extensive critical research examining lithium extraction in the context of Chile and Argentina, especially in recent years, using the perspectives of political ecology and just energy transitions (Dorn & Gundermann, 2022; Jerez et al., 2021; Voskoboynik & Andreucci, 2022). As the demand for lithium continues to rise, there is a growing need for similar place-based research in other regions as well, in order to better understand the social, political, and spatial dimensions of lithium extraction in areas on the verge of dramatic transformation.

The extraction of lithium from sedimentary clays represents a novel form of extraction that has expanded the scope of mining capabilities and increased the range for potential mining sites, notably in the McDermitt Caldera, the focus of this study. This expansion raises new uncertainties, and impacts a new set of communities, highlighting the need for more research to understand the range of potential impacts prior to initiating mining operations.

Lithium extraction in the Western U.S. is an evolving sector, and as of yet, little research from a political ecology perspective has been published, though there has been much attention from journalism and media to lithium development in Nevada. In particular, there has been little attention from either scholars or journalists to potential lithium extraction in Oregon. This study seeks to bridge this critical gap by focusing on perspectives around socio-environmental change associated with lithium extraction in Oregon. First, I employ qualitative methods to capture perspectives on the social and environmental changes prompted by mining activities. Additionally, I use GIS to examine spatial dimensions of mining on natural habitats and the potential consequences for biodiversity. The overall aim is to contribute a nuanced, place-based, and critically-informed understanding of the lithium extraction sector's development and its broader implications.

3. Research Questions

In this research, I examine the social and spatial dimensions of potential open-pit lithium mining within Oregon's section of the McDermitt Caldera. This study was divided into two parts. First, I used qualitative methods by conducting semi-structured interviews with 15 participants to better understand narratives and perceptions surrounding mining operations in the area. The central questions for my qualitative analysis were:

1. How do actors involved in Oregon's portion of the McDermitt Caldera perceive lithium as a strategy for decarbonizing?

2. How do these perceptions underscore support for or opposition to open-pit lithium mining in the McDermitt Caldera, Oregon?

Once interviews were completed, data from the interviews informed my third research question, which used spatial analysis methods to ask:

3. How does the spatial extent of mining operations interact with habitats of sensitive species within Oregon's Northern Basin and Range ecoregion?

4. Setting and Background

In this section, I overview the General Mining Law of 1872, which is the guiding federal law for mining in the United States. Then, I introduce the setting of this research, the McDermitt Caldera, which is located along the Oregon-Nevada border. Lastly, I focus on Oregon's section of the Caldera, as this is the area of interest for this research.

4.1 The General Mining Law of 1872

Regulation of mining activities in the United States is a complex, multi-tiered process with oversight responsibilities distributed across federal, state, and local governments, each with their own agencies and laws (Marcus, 1997). Mining operations go through various stages, including exploration, discovery, development, production, and reclamation, all of which are subject to regulations from multiple agencies. States often have delegated authority to enforce regulations, establishing their own standards (Hudson et al., 1999; Spitz et al., 2019). All stages of mining require government-issued permits to meet environmental compliance standards throughout operations and mine closure.

The General Mining Law of 1872 was established during the Gold Rush era of Western settlement and continues to serve as the primary legal framework governing hard rock mineral extraction on public federal lands in the United States. This law grants private individuals and corporations the opportunity to access federal public land for the exploration and exploitation of valuable minerals, designating such land as "free and open for purchase", without having to pay federal royalty for the financial gains made on public land (Bakken, 2011, p. 27).

Under this law, any individual may access federal lands to search for and develop minerals without the need for prior authorization or payment of fees. The process for securing exclusive rights to extract minerals begins with the staking of a claim, where the claimant marks the boundaries of their mining area and posts a notice of intent. This action grants the claimant the privilege to extract minerals from within their designated claim, which can subsequently be sold.

The law offers the opportunity to obtain a patent for land containing valuable mineral deposits. Through obtaining a patent, a claimant gains full title in fee to both the minerals and the surface land. A person can claim ownership only when they discover what is deemed a "valuable mineral deposit". Additionally, the law prioritizes mining activities over other land uses for the “highest and best use” on public lands (Earthworks, 2019), and claimants are allowed to use as much land as reasonably necessary for mining purposes (Bakken, 2011; Mayer, 1986).

Given the General Mining Law’s limited consideration for environmental hazards associated with mineral exploration and exploitation, supplementary laws have been implemented to address the limitations of the original mineral exploration and exploitation guidelines at the federal level (Woody et al., 2010). Prominent environmental laws that regulate mining at the federal level include the National Environmental Policy Act (NEPA) of 1969, which requires environmental review for federal actions; the Clean Air Act (CAA) of 1970 which regulates airborne pollution; the Clean Water Act (CWA) of 1977 that regulates toxic and nontoxic pollutant discharges into surface waters; the Resource Conservation and Recovery Act (RCRA) of 1976 which regulates of hazardous wastes into the environment from generation to disposal; and the Toxic Substances Control Act (TSCA) of 1977 that controls the use of chemicals in mining. These laws task federal agencies, notably the Environmental Protection Agency (EPA), with oversight responsibilities (Hudson et al., 1999; Marcus, 1997). Regarding federal oversight over mining activities, many believe the General Mining Law of 1872 to be antiquated, with several attempts to amend the law throughout the past decades (Huber et al., 2009; Knutson et al., 1981). At the state level, the process of seeking approval is based largely on policy, which varies between states (Marcus, 1997).

4.2 The McDermitt Caldera

The McDermitt Caldera is located on the border of southeast Oregon and north-central Nevada, it's northern extent just southeast of the Steens mountains and directly east of the Trout Creek Mountains (see Figure 1). This area hosts the ancestral territories of the Northern Paiute, Bannock, and Shoshone peoples. The nearest population centers include the Fort McDermitt Indian Reservation, along with the town of McDermitt, both spanning across the Oregon-Nevada border and both bifurcated by U.S. Route 95. The Caldera is primarily located on public land managed by the Bureau of Land Management (see Figure 6 for a detailed map showing BLM land). McDermitt Creek, originating in Oregon, is the northern extent of the Quinn River watershed, which drains south into the Quinn River sink of Nevada's Black Rock Desert.

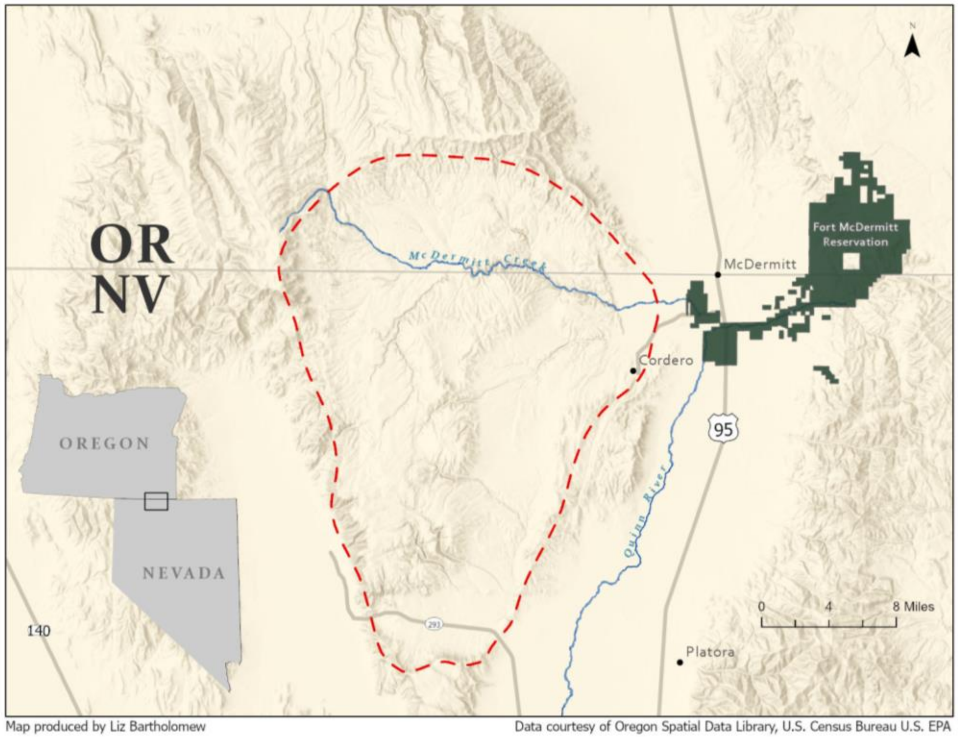

Figure 1: Map of the McDermitt Caldera on the Oregon Nevada border. The outer rim of the Caldera is outlined by red dashed lines.

Once an eruptive supervolcano fed by the Yellowstone hotspot during the Eocene, the McDermitt Caldera was formed after volcanic collapse. Its basin-like structure then became a lakebed enclosed by mountain and buttes (Henry et al., 2017; Parks, 2022a; Rytuba, 1976). The combination of water, volcanic minerals, and time formed several ore deposits in the local sedimentary clays, notably mercury, uranium, and lithium (Rytuba, 1976).

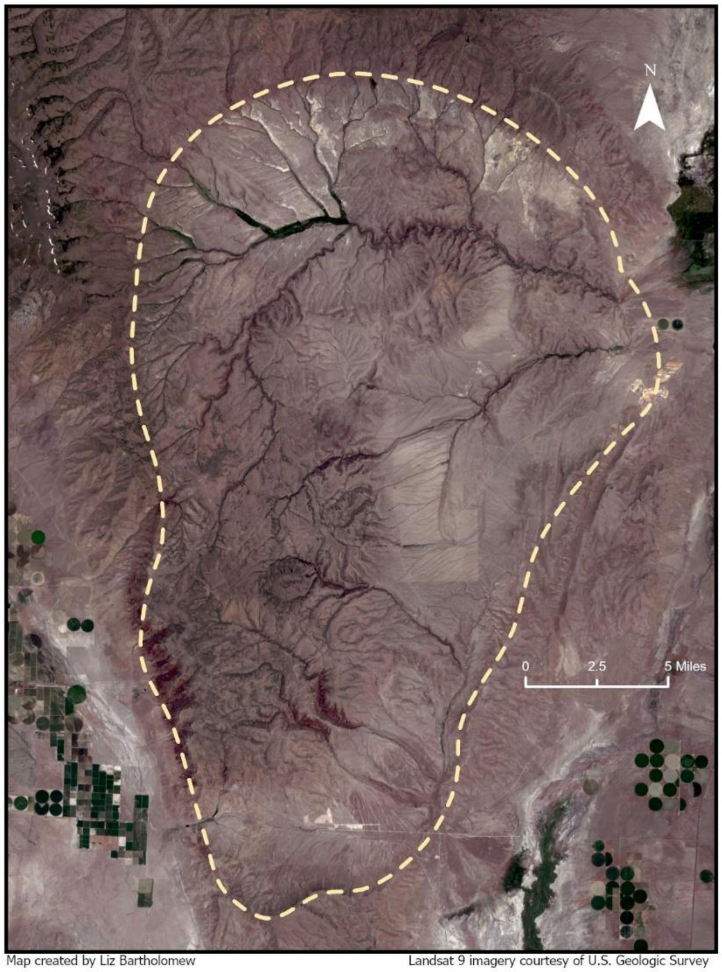

Figure 2: Satellite imagery of the McDermitt Caldera on the Oregon Nevada border. The yellow border represents the outer rim of the Caldera.

Mercury and uranium mines occupied the rim of the Caldera throughout the 20th century, with mining operations concluding in the 1990s (Dunning et al., 2019). As recently as 2012, the Environmental Protection Agency (EPA) removed toxic mine waste used as fill from two decommissioned mercury mines, the Cordero and McDermitt, in the town of McDermitt and the Fort McDermitt Paiute Shoshone Reservation. This cleanup addressed exposure risks to mercury and arsenic. (Environmental Protection Agency, n.d.). Today, evidence of past mining operations can be seen in scarred pockets of the landscape, along with abandoned mining equipment (see figures 3-5).

Figure 3: Abandoned mining equipment in the Caldera. Photo by author.

Figure 4: Abandoned mercury mine in the McDermitt Caldera, Oregon. Photo by author.

Figure 5: Expansive sagebrush habitat in the foreground, waste pile from an abandoned mercury mine in the distance. Photo by author.

Lithium's popularity has increased due to its use in modern battery production. Its critical mineral status, paired with the growth of the electric vehicle industry, has brought the McDermitt Caldera's unique geology and known lithium reserves into focus. Several claims now line the Caldera, with claimholders in various phases of exploration, discovery, and development.

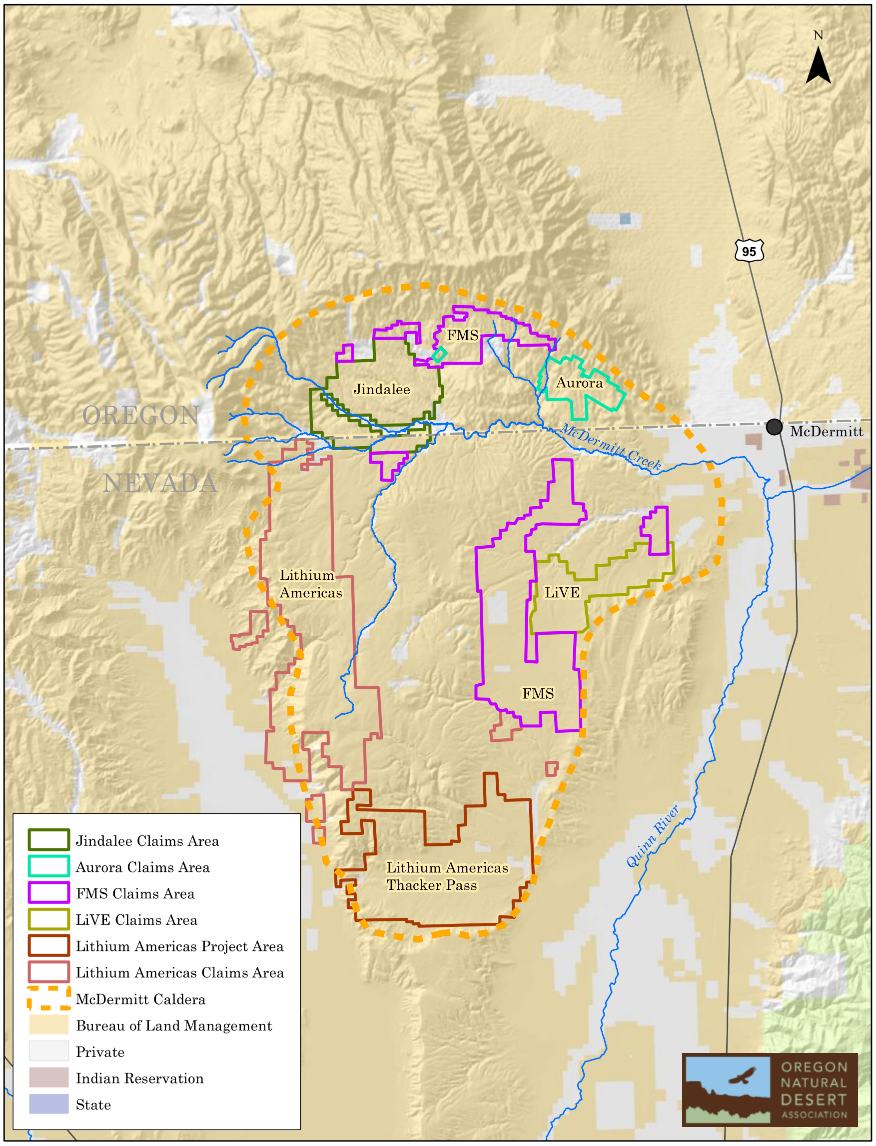

Figure 6: Lithium claims in the McDermitt Caldera on the Oregon Nevada border. Map created in 2023, courtesy of Oregon Natural Desert Association (ONDA).

4.3 Thacker Pass

Beginning in 2019 the Thacker Pass project, managed by Lithium Nevada (a subsidiary of the Canadian-owned Lithium Americas) progressed rapidly due to an accelerated environmental review and limited community consultation (Kapoor, 2021). Situated in the southern part of the Caldera, the proposed open-pit mine covers an area of 18,000 acres. This includes a 2.3 mile-wide pit, an on-site sulfuric acid plant, and an estimated annual groundwater consumption of up to 1.6 billion gallons (Basin and Range Watch, 2023; Blair et al., 2024). To extract lithium from the sedimentary clays of the McDermitt Caldera, clays are removed and crushed via hydraulic shovels, combined with water to create a slurry, mixed with sulfuric acid to chemically separate the ore from its host rock, then undergo further processing to produce lithium carbonate (Lightcap, 2022; Lithium Americas, 2002; Nevada Division of Environmental Protection, 2022).

Resistance to the mine has grown over time, with a coalition of environmental non-profits, local ranchers, and pan-Indigenous groups raising concerns over the environmental and cultural impacts of the mining operations, in addition to the rushed and potentially insufficient permitting process.

Figure 7: Billboard from the pan-Indigenous group People of Red Mountain along Highway 95, Oregon-Nevada Border. Photo taken by author.

Environmental concerns related to mining activity include air and water pollution, damage to local flora and fauna, and persistent water use in the water-scarce desert that is the Great Basin. The site of Thacker Pass (known as Peehee Mu'huh in Paiute) holds significant cultural importance to many Indigenous groups. In addition to its utility as a sacred place for hunting and gathering medicines for local Indigenous communities, Peehee Mu'huh is the site of an 1865 massacre of dozens of Paiute men, women, and children at the hands of U.S. Cavalry (Berglan et al., 2022; Rodiero, 2023; Sonner, 2021). Despite repeated attempts at litigation from environmental nonprofits, ranchers, and pan-Indigenous groups who have tried to halt the project, mining operations moved forward, construction began in March of 2023.

Figure 8: Active construction and site clearing at Thacker Pass. Photo taken by Katie Fite.

Lithium Americas has received substantial capital to support mine construction, including a $650 million investment from General Motors and a $2.26 billion conditional loan from the U.S. Department of Energy (Lithium Americas, 2024). The Thacker Pass project forecasts that it will produce enough lithium carbonate to support the production of up to 800,000 electric vehicles per year, create 1,800 jobs during the construction process and 360 jobs during the 40-year life of the mine (Lithium Americas, 2024; U.S. Department of Energy, 2024). Currently, the mine's creation is in its early phase of construction, which includes nearby road improvement for mining machinery, site clearing and pad excavation, commissioning of a water supply system, and early phase site infrastructure, which includes temporary offices, fences, security gates and security systems (Lithium Americas, 2024). Figures 8 and 9 include imagery of on the ground mine construction and satellite imagery of early phase construction activities.

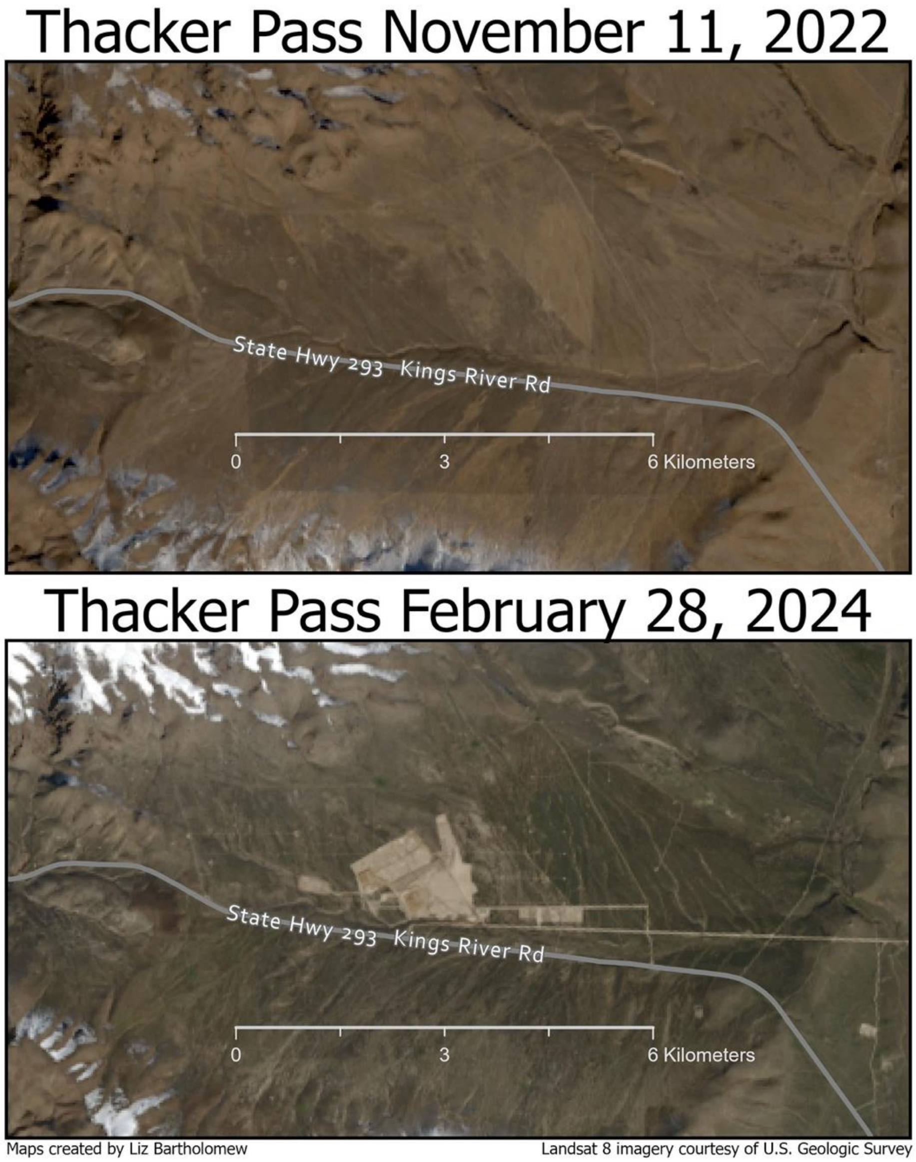

Figure 9: Comparative satellite imagery of Thacker Pass from 2022 (before construction) and 2024 (after construction began).

4.4 McDermitt Caldera, Oregon

Oregon's section of the Caldera, which is the area of interest for this study, lies within the southwest corner of Malheur County. The sparsely populated county covers 9,874 square miles, 94% of which is designated rangeland, with two-thirds managed by the BLM (Malheur County, 2016). Malheur's economy is strongly tied to agriculture and cattle ranching. Despite these economic drivers, Malheur County has the state's highest poverty rate and lowest per capita income (U.S. Census Bureau, 2022).

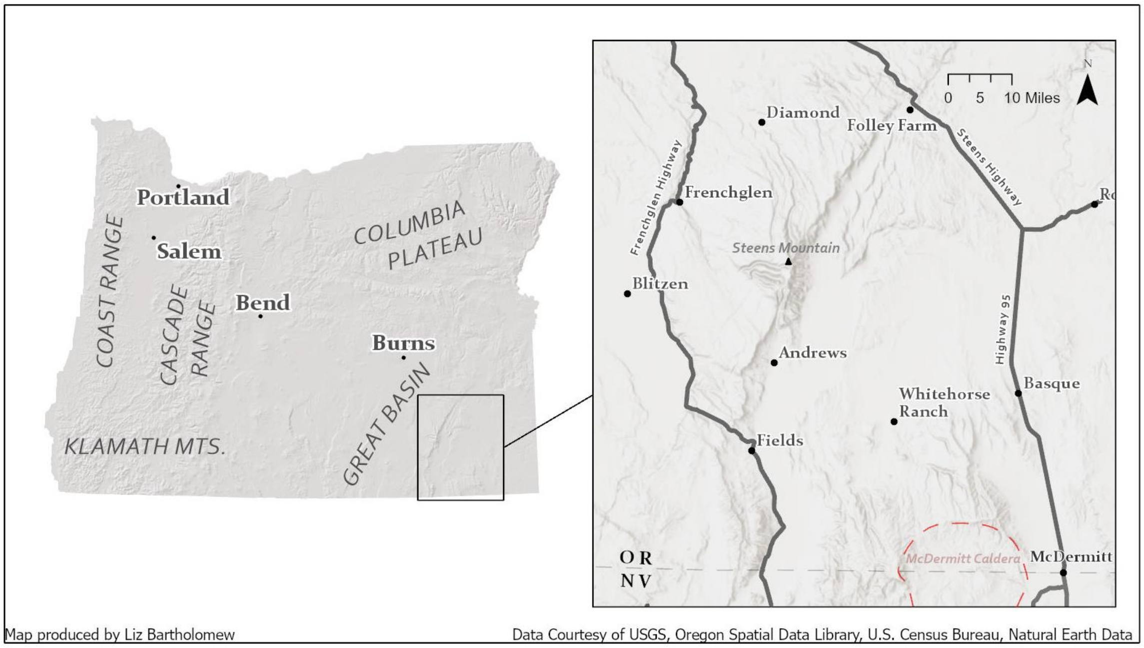

Figure 10: Study area: Map showing the northern reach of the McDermitt Caldera in southeast Oregon.

The northern extent of the McDermitt Caldera is in the Northern Basin and Range ecoregion, a level 3 ecoregion characterized by its unique geology, ecology, and climate. The level 3 ecoregion classification, part of a spatial framework for ecological management, identifies areas with similar characteristics and environmental conditions (see Figure 11).

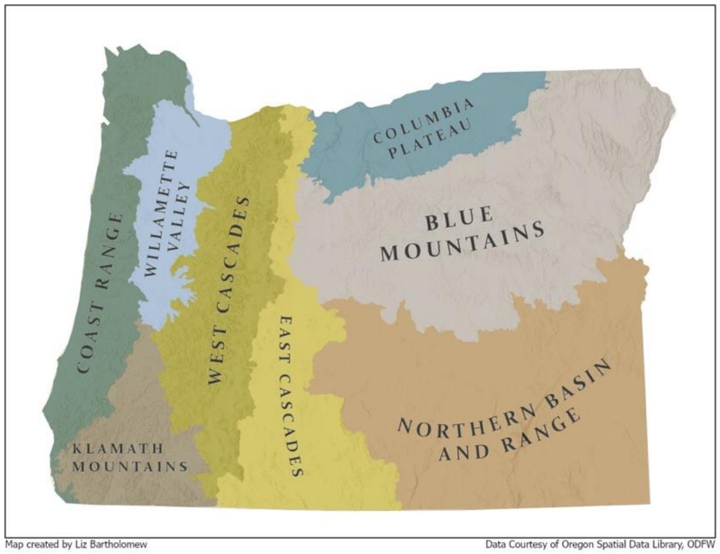

Figure 11: Level 3 ecoregions in Oregon, defined by their distinctive ecosystems, climate, and geography.

The Northern Basin and Range ecoregion is dominated by sagebrush-steppe and shrubland communities which have evolved to thrive under arid conditions. Often referred to as the "Sagebrush Sea" (see Figure 12) across the arid west, it is one of the most threatened ecosystems in the United States (Davies et al., 2011). This is largely due to invasive grass species and anthropogenic activities. The resulting fragmentation, degradation, or removal of sagebrush habitats has led to the decline of many adapted species, with over 350 plant and animal species now considered species of concern (Davies et al., 2011; Suring et al., 2005; Wisdom, 2005).

Figure 12: Expansive old-growth sagebrush, known as the “Sagebrush Sea”, within the northern reach of the McDermitt Caldera.

Of these species, the Greater Sage-grouse (*Centrocercus urophasianus*) mirrors the fragility of sagebrush ecosystems. Populations have plummeted due to habitat fragmentation, degradation, and loss. In 2015, the Sage-grouse narrowly avoided a listing under the Endangered Species Act, a designation which would have granted further protections. As a mitigating factor to avoid an Endangered Species listing, the BLM and associated state agencies were responsible for conservation measures to protect the bird. Following this, the Greater Sage-grouse Conservation Assessment Strategy was adopted in Oregon. This enhanced Sage-grouse protection by recommending a mineral withdrawal, or blocking of new mining claims, on 10 million acres of the best remaining habitat throughout the country, with the McDermitt Caldera included as a recognized focal area for supporting species survival (Oregon

Department of Fish and Wildlife, 2020a; Parks, 2022b; Preacher, 2015). These protections were quickly rolled back in the early days of the Trump administration, opening many areas, including the McDermitt Caldera, to mining operations (Lucas & Stellberg, 2021; Parks, 2022b). The last century has seen a 95% population decline of Greater Sage-grouse (Lucas & Stellberg, 2021). Oregon's population represents 6% of all remaining Sage-grouse and is considered a stronghold for the species (Oregon Department of Fish and Wildlife, 2020b).

Three corporations currently hold claims within Oregon's section of the Caldera (see Figure 13). HiTech Minerals, a subsidiary of Australian company Jindalee Lithium (formerly Jindalee Resources Ltd.) possesses the only permit to explore lithium in the Caldera. Exploratory drilling began in December 2022, followed by several press releases claiming to hold the largest and most profitable deposit of lithium in North America (Washbourne, 2024). In July 2023 HiTech submitted a new plan of operations to the Department of Geology and Mineral Industries (DOGAMI) and the BLM to continue exploratory operations, which would include the addition of 267 drill sites and the construction of 30.2 miles of new access roads (Bureau of Land Management, 2023).

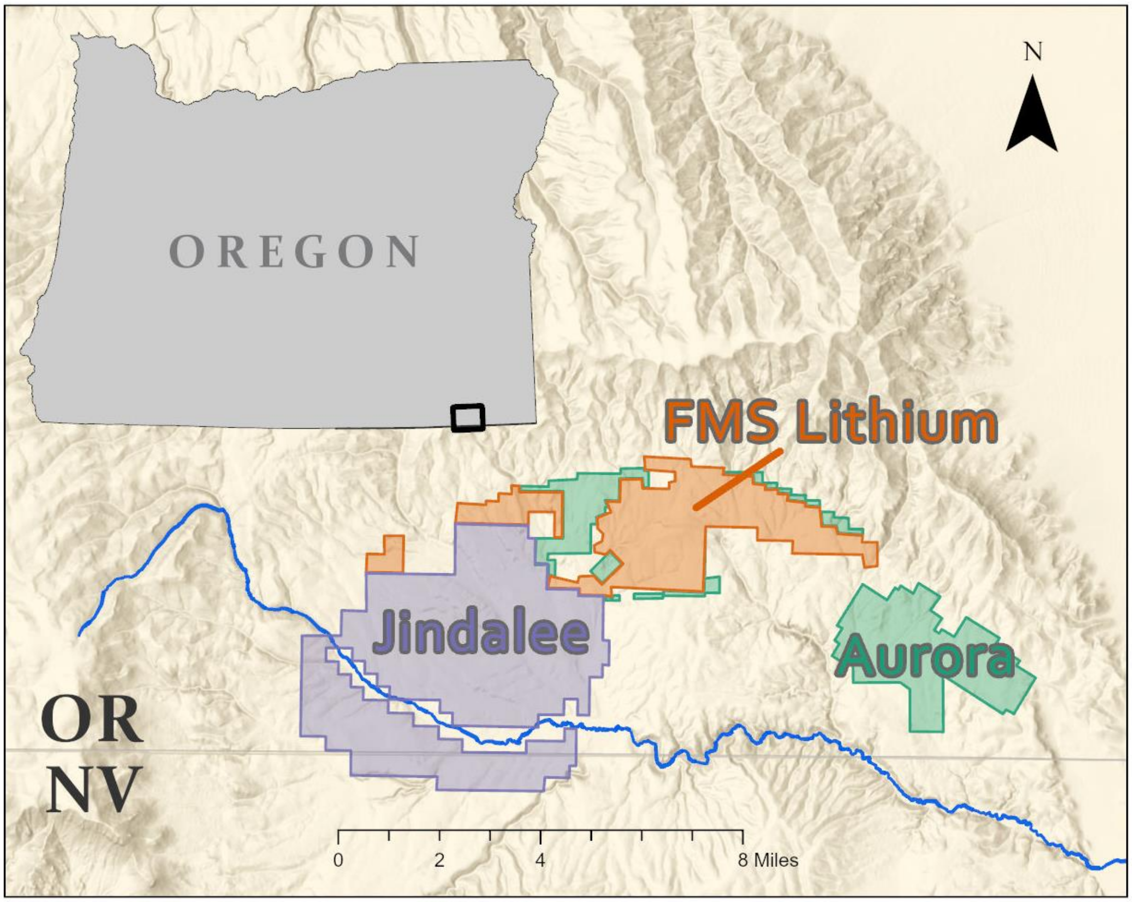

Figure 13: Mining claims within Oregon's section of the Caldera. Jindalee Lithium (also HiTech Minerals) is currently the only mining company to posses an exploratory permit.

Given the proximity, shared geology, and available technology, extraction logistics in Oregon's section of the Caldera would likely look similar to Thacker Pass, entailing an open-pit mine and sulfuric acid chemical separation. Currently, there are no mines that use chemical processing methods in the state of Oregon. The recent advancement of a gold mining operation outside of Vale, Oregon, has led many to believe that chemical process mining will soon be in the state. Prominent policy guidance for mineral extraction within the state is the Oregon Revised Statute (ORS) 517.760, which acknowledges the economic role of mineral extraction for the state, while mandating environment and cultural resource protections from the potential adverse effects of mining. The law requires rehabilitation of mined areas to prevent degradation of land, water, and public welfare. Per the statutory language of ORS 517.760, the 1991 Oregon Legislature created House Bill HB2244, which provided a regulatory framework for chemical process mining within the state. The bill designates DOGAMI as the primary coordinating agency for issuing permits, while maintaining regulatory requirements from other state agencies under a Consolidated Permit. Table 1 outlines prominent agency involvement within the Consolidated Permit process and the administrative rules that guide statutory authority for each agency. Permitting agencies include the Oregon Department of Environmental Quality (DEQ), Oregon Water Resources Department (OWRD), Oregon Department of State Lands (DSL), and the Oregon Health Authority (OHA). Additionally, Oregon Department of Fish and Wildlife (ODFW), Oregon State Historic Preservation Office (SHPO), and Oregon Department of Agriculture (ODA) act as coordinating agencies to maintain compliance with state standards (Oregon Department of Geology and Mineral Industries, 2023). Within the mining industry, many found HB2244 convoluted and intentionally challenging to achieve permitting to proceed with chemical treatment mining (Oregon Department of Geology and Mineral Industries, 1992).

Permitting Agency	Administrative Rules	Purpose and Goal
Oregon Department of Geology and Mineral Industries (DOGAMI)	OAR 632-037	• Implements Consolidated Permit • Coordinates federal and state permits in the Consolidated Permit • Uphold state policy to protect environmental and public health
Oregon Department of Environmental Quality (DEQ)	OAR 340-043	• Prevent water pollution and protect environmental and public health • Mandates use of available and reasonable wastes and chemical control methods • Targets operations producing waste or wastewater with toxic chemicals
Oregon Department of Fish and Wildlife (ODFW)	OAR 635-420	• Develop conditions for the protection of wildlife and their habitat
Oregon Water Resources Department (OWRD)	OAR 690-078	• Quantify water to be appropriated

Table 1: Prominent institutional involvement in the Consolidated Permit process.

The progress of the potential Grassy Mountain gold mine, which would use on-site cyanide leaching processing methods, has led many to believe that chemical process mining will soon be operational in the state of Oregon and will usher in a new era of mining (Parks, 2022c; Rose, 2023). Because of the multi-agency permitting process and high environmental standards mandated by the state, no chemical treatment mines have ever been issued a Notice to Proceed (NTP) from the state (Rose, 2023). In November of 2023, DOGAMI issued an NTP for the Grassy Mountain Mine, allowing the mine to move forward into the next phase of permitting (Paramount Gold Nevada Corp., 2023).

5. Qualitative Methods

To understand how open-pit lithium mining within Oregon's section of the McDermitt Caldera was being perceived from a variety of involved actors, I conducted semi-structured interviews with key participants. To identify key participants, I began by attending a 3-day field trip in May 2023 within the McDermitt Caldera, Oregon, with the non-profit group Oregon Natural Desert Association (ONDA). The field trip was an informative session focused on potential lithium mining within the area, and brought local Tribal members, environmental professionals, ranchers and engaged citizens together to discuss social and environmental impacts that could occur from mining operations specifically within Oregon's section of the Caldera. After this field trip, I used purposive sampling methods and identified certain individuals from the event as potential participants based on their level of involvement within the McDermitt Caldera, Oregon. I then reached out via email, phone, or the employment-focused social networking application LinkedIn.com to ask for an interview.

Interviews began with the identified participants from the field trip. In all interviews I used snowball sampling methods, which involved asking interview participants to recommend other contacts involved within the McDermitt Caldera. Parker et. al. (2019), describes snowball sampling methods as effective in their ability to "capture an increasing chain of participants". This was true for my process, as I identified and contacted 41 potential participants. Due to the proximity to Thacker Pass and the high volume of engagement happening within this region, interview participants were selected based on their involvement specifically within Oregon's section of the Caldera, and recommendations for participants involved solely with the Thacker Pass mine were not pursued.

Of the 41 potential participants who were identified, several did not respond or expressed discomfort with the political nature of speaking openly about mining operations (this was especially true for mining representatives and certain state and federal employees involved in the permitting process). In total, 15 semi-structured interviews were conducted from July to December 2023 with a broad spectrum of participants. To protect anonymity, participants were given pseudonyms and were then placed in a generalized group category (see Table 2). Interviews lasted between 30 to 90 minutes, with open-ended questions relating to perspectives on energy transitions, lithium mining, and personal connections to the McDermitt Caldera (see Appendix A). Due to the geographic distance between me and the participants, interviews were conducted and recorded over the video conferencing service Zoom as a method of convenience. One interview took place over the phone, which was simultaneously recorded on the Voice Memos application on my MacBook Pro. Recordings were then transcribed using the speech-to-text transcription service Rev.com. I then reviewed and edited transcripts as needed to ensure accurate transcription.

Table 2: Interview participants by category.

Group Category	Number of participants
County Commissioner	1
Engaged Citizen	1
Documentarian	1
Non-profit Representative	5
Wildlife Biologist	1
Mining Representative	1
State Employee	4
Rancher	1

5.1 Data Analysis

Transcripts were imported into MAXQDA Analytics Pro software, a program used for computer-assisted qualitative data analysis. Interview data was analyzed using a combination of thematic analysis and a general inductive approach. First, I used a general inductive approach when engaging with the data, which Thomas (2006) describes as "…allow[ing] research findings to emerge from the frequent, dominant, or significant themes inherent in raw data" (p. 237). This entailed line-by-line open coding where I identified categories within the transcript data. During this process, I wrote several memos about which codes were similar, how they may relate to other codes, and what their larger context might mean. Once the initial round of coding was complete, I wrote a codebook that included detailed descriptions of each code's meaning, with supporting quotes that best represented each code. In total, more than 40 codes were used to interpret the large body of data, with examples including "concepts of change," "thoughts on green energy," "trade-offs," "trust and distrust," and "values".

For the second round of coding, I used thematic analysis to construct themes from the identified codes and summarize the data under what Braun and Clarke (2006) refer to as "key" themes, which are broad categories that embody several of the identified codes. This entailed reviewing my codebook, compiling the codes into potential themes within MAXQDA, then defining and naming the key themes.

6. Qualitative Results

This research asks how lithium use is perceived and how these perceptions underscore support for or opposition to open-pit lithium mining within the McDermitt Caldera. Based on my interview data I identified four key themes that help answer these questions: 1) ambivalence with renewable energy, 2) uncertainty with unknowns, 3) landscape values and connections, and 4) imaginaries around time, space, and potential futures for Oregon**.** These themes are explored in detail in the sections that follow.

6.1 Ambivalence Towards Renewable Energy

Research exploring attitudes around renewable energy technologies has shown the complexity of the issue, highlighting a shared understanding that climate change poses an existential threat while demonstrating the contrasting levels of acceptance and varying discourses toward specific technologies from actors involved in the process (Jessup, 2010; Pavlowsky et al., 2023; Spangler et al., 2024). While there were divergent perceptions regarding open-pit lithium mining within the McDermitt Caldera, there was a shared ambivalence towards renewable energy technologies among interview participants. Uncertainties coalesced around participants' skepticism that the current proposed solutions are a) achievable and correct solutions, b) addressing the real issues, or c) worth the high costs of transitioning.

6.1.1 Skepticism of renewable energy technologies

Increasingly, critical scholarship has engaged with issues of renewable energy, raising questions around the negative impacts of “green” energy (Avila-Calero, 2017; Giglio, 2021; Rehbein et al., 2020; Sánchez & Ruiz, 2023). This theme was brought up strongly by interview participants. For example, Nick, a rancher whose family has lived in the northern reach of the McDermitt Caldera since the 1870s, questioned the expediency with which climate goals and renewable energy technologies have been presented, commenting:

> I don't have the scientific background to say yes […] or no, but man, the way we've jumped into this thing, it took a hundred years to make automobiles, gas automobiles […] and we're going to do this clean energy in what, 10 years? Good luck!

Nick’s sentiments were similarly reflected by Sam, a representative of an environmental non-profit opposing mining operations:

> There's no free lunch. We're not just going to create all this free renewable energy. In fact, renewable energy is sort of a misnomer. It's actually rebuildable. We're still having to make new batteries, rebuild wind turbine blades and remake solar panels. All this stuff is all rebuildable. Is this going to power the same civilization we have now? Probably not. Can it power a different civilization? Yes. Will it look the same? No. You can't replace fossil fuels. You just can't.

Sam emphasized the uncertainty that transitioning from fossil fuel use to alternative energy systems will likely not be observed within a timespan that the existing civilization will experience, and that common beliefs behind “green” and “sustainable” energy are misbranded because they are still systems that require labor, materials, and capital. Similarly, Ryan, a state employee involved in the permitting process, addressed the paradox of pursuing renewable energy technologies that, while aimed at cutting fossil fuel reliance, still contribute to high carbon emission and landscape alterations. Ryan commented:

> It's a real conundrum, this. Because you want to encourage the development of electric technologies, renewable power, et cetera, that reduce our reliance on oil and gas and coal. But now here we are, proposing to dig up more ground and probably emit a lot more carbon emissions to produce something that's supposed to do the opposite, but there's no real way around it.

Ryan's comment on this "conundrum" highlights the ambiguity with the production of renewable energy technologies and the misnomer that they are as "clean" as often advertised. This sentiment was reflected by Chris, a geologist involved in the permitting process, who also commented on the misrepresentative language embedded within renewable energy technologies, saying that:

> Green is a relative term here because it's hard to generate energy without some carbon footprint, and the question is, are you generating power from a source that has a lower carbon footprint than gasoline? So that's the drive here. The technology is effectively proven. […] I can't remember the number of cars that went onto the roads in Oregon in the last year, but it was something in the order of 50,000 EV vehicles in Oregon […]. So that direction is set because the technology is there. Is a better alternative hydrogen? […] Maybe, but it's second. And so part of this is an arms race who got there first, and EVs got there first, and that's why we're here. I think the status quo is not going to work, meaning we can't stop. […] We can't get there in the status quo because energy demand is so high. So how do we get there? […] And I think that's where we are, that lithium has a role in reducing CO_2 into the atmosphere. It's not a perfect fix, but then there is no perfect solution.

Chris described lithium as "not a perfect fix," but he acknowledges that EV technology was first in the "arms race" for renewable technologies that are attempting to decarbonize. This position underscores the nuanced, complicated nature of these technologies, acknowledging that there is no easy solution for uprooting our current energy systems and that lithium is one strategy that is furthest along, and therefore has reached a high level of societal acceptance.

6.1.2 Issues of consumption

Scholars have recently questioned the assumption that it is possible or desirable to continue status-quo energy usage by simply swapping renewables for fossil fuels, suggesting instead that broader transformations to, for example, transportation systems may be what is needed (Riofrancos et al., 2023). This issue of consumption was raised by interview participants: for example, Chris discussed the problem of high energy demand being the status quo, stating that this is “not going to work”. Consumption was a recurring topic among participants, many of whom felt that human habits of overconsumption were not being addressed, and that exchanging a gasoline vehicle for an electric vehicle does not confront the core reasons that led humans to the current climate crisis, thus reinforcing suspicions of renewable energy technologies acting as a true solution. When reflecting on national prioritization of renewable energy technologies, Katie, a representative of an environmental non-profit, said: “It's insanity, total insanity, how we're going. It's the total frontier mentality. Manifest destiny, just rolling along, keeping control of energy […] and not addressing overconsumption.” Katie's distrust of renewable energy technology and the power structures involved in this process is clear. She also emphasizes that the issue of overconsumption is being neglected in the discourse regarding climate change mitigation, energy transitions, and decarbonization. This idea is also explored by Dan, a representative from a non-profit centered around social and environmental advocacy. Dan stated: “The corporate story that we're hearing is that everybody gets a sexy electric truck. You don't have to really suffer, and you don't feel any guilt from climate change. You can say that in a sentence. It's quick, it's easy, it's great… it's not really great.” Dan’s comment that “you don’t have to really suffer” emphasizes the sentiment that consumptive habits do not have to be negotiated and expresses his disapproval of a “quick fix” narrative that is used on consumers to not feel guilt or any sense of responsibility about climate change.

A contrasting perspective regarding consumption and personal responsibility was posed by Mike, a documentarian chronicling the developments surrounding the McDermitt Caldera. Mike stated:

> It is just a little more realistic than telling people to reduce their consumption, […] to provide them with something that they can still live the same level of quality of life but emit less carbon with that lifestyle. So I think […] lithium, at least in the short term, while we're still using lithium, is definitely a good thing for our country and energy independence.

This was a unique understanding of the larger opinions held surrounding personal responsibility and consumptive habits. Mike felt that high levels of consumption are inevitable, and that the approach of meeting consumer needs through alternative technologies is a good solution for both decarbonizing as well as energy independence.

6.1.3 The costs of renewable energy technologies

Concerns with the costs involved with renewable energy technologies also led to feelings of ambivalence. Participants emphasized that costs go beyond just dollars. Many participants felt that energy transitions were a trade-off which involved sacrifice, often at the expense of nature. Matt, a wildlife biologist who has performed extensive research within the Caldera, emphasizes this point when he stated:

> We need to transition out of fossil fuels. Nothing's for free. Wind energy, there's nothing for free. We kill raptors, we kill bats, we kill millions of things a year with wind turbines. […] I think one of the largest questions that's facing government and all those that are vested in this place [the McDermitt Caldera] and in this potential project is if impacts occur, the reality is that you're not going to replace it […] you have to always recognize that what's been lost is lost.

Matt's statement highlights the importance of transitioning away from fossil fuels, while also acknowledging the ecological losses that happen in spaces of extraction and energy production. His statement that "nothing's for free" expresses the environmental costs associated with energy transitions, and how these costs can evoke a feeling of loss of a place. Nick, the rancher, reflected this sense of loss when he remarked:

> We're not really solving the problem. We're going to tear up the Caldera so we can have an electric car, or we tear up the ozone because we got a gas car. […] we're not solving anything. […] Green energy doesn't look so green when you look at what it's going to destroy.

Nick's distrust of the mechanisms behind "green" energy and his perceptions of loss are apparent within this statement. The comparison of destruction of either the Caldera —via lithium extraction, or the ozone — via the burning of fossil fuels, demonstrates feelings of distrust and skepticism that both options have undesirable costs and trade-offs.

The scale of benefits can be understood in a variety of ways. Jessup (2010) frames the juxtaposition of certain renewables as "…environmentally beneficial and locally destructive" (p. 21). This concept is explored by Mike, who openly questioned the scale of sacrifice:

> What's really interesting about this conflict is that when you're there in the Caldera and you're looking around at the beautiful sagebrush or any of the songbirds, you really get a sense that this area should be preserved. But then when you turn on the news, when you get home and you're looking at record

> temperatures currently in the summer that so much of the globe is experiencing now, you start to think, 'oh, right, there's a bigger world out there than just the songbirds and the Sage-grouse that exist in this one part of the Caldera.' And you start to think about what is the right answer?

Mike's statement raises important questions about the scale of sacrifice and the trade-offs involved. He highlights the existential threats caused by climate change at the global level, openly questioning if one location (the McDermitt Caldera) has higher value than the rest of the "bigger world out there". This debate has been widely explored in literature as well as the media, with some scholars arguing that there will be winners and losers in the energy transition, and people need to "get over it" (Roth, 2023) for the larger goal of avoiding climate collapse. Others argue that this binary outlook lacks imagination and fundamentally accepts the current methods towards decarbonizing without critiquing their implementation (Joshi, 2023; Knuth et al., 2022; Turley et al., 2022).

Ideas of loss and destruction were shared among participants who opposed mining within the Caldera, many of whom recognized the need to change current energy systems but felt that an open-pit mine within the McDermitt Caldera had a cost that was too high. Diverging perceptions of sacrifice for the "greater good" were also present. There were no definitive answers about the correct solutions for combating climate change, but there was a shared sense of skepticism surrounding lithium mining as an effective solution to climate change.

6.2 Uncertainty and Unknowns

The lack of clarity and transparency associated with mining activities was a common topic for participants. Scholarship surrounding public acceptance of large-scale renewable energy projects has shown recurring examples of obscured data, a lack of public consultation and performative attempts at public relations, which often leads to conflict and uneven distribution of burdens (Dunlap & Riquito, 2023; Newell et al., 2022; Martiskainen & Sovacool, 2021; Upham et al., 2022). Perceptions surrounding unknowns included in this process revolved around the novel nature of this mining technology and its presence in a state with limited hard rock mining operations, uncertainty with impacts on local water sources, and knowledge gaps that are a byproduct of administrative boundaries.

6.2.1 Novel technologies, novel industry for Oregon

The technology used to extract lithium from sedimentary clays is a relatively new one, and lithium mining itself represents a new form of industry for the state of Oregon. As Lisa, a representative from an environmental non-profit, commented:

> It seems that people are concerned because this is a very new situation. There's never been mining to this scale in the area. There is a history of mercury mining in the area and some other smaller mines, but nothing at this magnitude that would have the lifespan that this mine would have in the past.

A similar sentiment was expressed by Will, a state employee involved in the permitting process:

> It'll be the first lithium mine in Oregon if it goes through. And so there's a lot of unknowns. […] I think that's kind of the role of government is to maybe make sure that some of those unknowns are accounted for and maybe some of

> the impacts that might come along with an unregulated mine are accounted for as well.

From a regulatory standpoint, certain state employees, including Will, highlighted the unprecedented nature of lithium mining for the state of Oregon and emphasized the need for responsible oversight. Ryan reenforced this idea when he says: “Projects like this one, […] they're controversial at the outset and they're also something that people in our agency don't have any experience with. So it kind of catches everyone off-guard, and there's not a lot of precedent.” The idea of regulators being caught “off-guard” evokes a certain discomfort with the novelty being presented. This viewpoint is distilled by Jennie, a representative from a non-profit centered around social and environmental advocacy:

> Oregon doesn't have a big mining history, so there's not a lot of systems in place around mining in the state. […] And so there are technologies that are new here and regulations that we don't have to safeguard against those.

This is different than, for example, the Nevada side of the McDermitt Caldera, since Nevada has a long history with mining. The introduction of a new form of extraction and industry to the state of Oregon raised a shared sense of importance regarding the identification of unknowns and the need to address knowledge gaps.

6.2.2 Water

Because hard-rock mining requires a stable supply of water from a local source, issues relating to water were frequent topics of concern for participants— a concern which extends beyond this local case and applies to many mining projects (Kemp et al., 2010). This is especially true for the Great Basin ecoregion, which has limited precipitation and groundwater dependent ecosystems (Albano et al., 2021).

Regarding water within the McDermitt area, participants highlighted issues of water use and contamination relating to mining activities,. When I asked where they would like to see more clarity regarding mining methods, Ryan replied:

> I don't really know all that much about it, […] exactly what the mining process is, but it's fairly water intensive, so that's an issue. How much water is actually going to be used in the process? […] What are the chances that groundwater is going to be permanently impacted, not just how much water there is, but how clean the water is, right? Is it going to make water in this area, which is somewhat undrinkable already, even less drinkable? I mean to the point where wildlife actually cannot survive? […] So that's another question, water quality and how widespread water quality damage could be.

Ryan's statement underscores many questions relating to the mine's water use and its potential effects on water quantity and quality. Later in our conversation Ryan added: "One of the interesting things about that area is that there's been so little development down there up until now, especially concerning groundwater, […] we don't really have a whole lot of information". This sentiment compounds the lack of data known about water within the region, in addition to the amount of water that will be used. Similar concerns over water were also expressed by Jane, an engaged citizen who frequently volunteers in the Caldera on ecological-related outings:

> I don't think there's sufficient data and I don't know if they [the mining companies] have any plans to try to get it to prove that that's going to be the case. And just from all my experience and every area of the country that has ever tried to withdraw too much water from the groundwater, watching the effects of that, it is hard for me to believe [that] all of a sudden in this area it's going to be completely unique and withdrawing that much water from the groundwater, it will have no effect on the local water table. And again, it's a desert, so they really can't spare this amount of water for mining.

Jane's framing that the Caldera is part of a desert ecosystem, where water is often scarce, serves as a reminder of water's importance. Additionally, Jane expressed skepticism regarding groundwater extraction by mining companies without first having "sufficient data" relating to local groundwater tables.

6.2.3 Data gaps due to administrative boundaries

Given that the McDermitt Caldera spans across two states, there are multiple administrative boundaries and contexts, which can contribute to knowledge gaps. Milman et al. (2020) explains that knowledge gaps in transboundary settings are often the result of several decentralized entities, which leads to knowledge fragmentation. This was a frequent topic when interviewees discussed regulatory oversight of mining activities, and the lack of inter-state collaboration was seen as a weakness on the part of regulators. For example, Ryan described:

> And so, and I think maybe you hit on something where you get these kind of cracks. It's almost like at state borders, […] there are borders between agencies, what's in their purview, and whose job is it? Is it Fish and Wildlife? Is it Water Resources? Is it even some of the federal agencies? And I think it largely depends on what's happening at the time and kind of whose territory it is.

While the landscape is contiguous, the perception that there are "cracks" in the regulatory systems due to administrative boundaries and a lack of communication regarding oversight adds confusion, gaps in data, and unknown roles and responsibilities between entities. Regarding Oregon's regulatory oversight, Lisa reenforced this observation: "Unlike other [natural] systems in Oregon that are completely within the state, the state wants to understand those, there's been less incentive to understand this one [the Caldera] because there's so little of it that falls within Oregon." Lisa's insight that there is "less incentive" to fully understand the natural systems which include the ecology, water systems and wildlife due to the state boundaries underscores Ryan's concept of "cracks" in the system, and the bureaucratic hurdles that can take place in defining administrative responsibilities.

6.3 Landscape Values and Connections

When I asked participants what the McDermitt Caldera meant to them, many interviewees expressed a sense of connection to the landscape that aligned with their value system. Many described the Caldera as a truly unique place, expressing a fondness for open landscapes, intact habitat, and the Caldera as a rare "wild" place for both human and non-human life. Often, it was within these descriptions of value and meaning for the McDermitt Caldera that ideas of preservation and opposition to mining activities arose. These sentiments are representative of what Brown & Brabyn (2012) describe as "…humans [being] active participants in a landscape — thinking, feeling, and acting — leading to the attribution of meaning and the valuing of specific landscapes and places" (p. 84). Sam emphasized the landscape's personal importance to him: "You go out there, I mean there is nothing, everything. I consider that everything. Most people say nothing, but it's everything. And it looks like it's endless." Sam's idea that "nothing is everything" speaks to the aesthetics of the Caldera; limited signs of human intervention, expansive views, and a contiguous landscape. Matt expressed a similar connection to the landscape: "You're dealing with one of the last wild places in eastern Oregon." Later in the conversation, Matt reflected on the significance of the Caldera: "I mean, half of my ashes will be scattered there." Both Matt's and Sam's statements are rich in emotion and strongly communicate how their feelings on the vastness of a landscape and feelings of wildness resonates with their sense of place.

The word “intact” was used by many participants when describing the McDermitt Caldera. Musing on a visit to this area, Felix, a state employee involved in the permitting process, stated: “[There’s] a lot of it really intact ecology, and I treasure that. I think there's great value in not only recognizing that we have it, but there's wisdom in recognizing what would things be like if we didn't.” Felix underscores valuing the ecological aspects of the Caldera while expressing caution for losing such places. Lisa echoed the ecological importance and significance of place:

> The species that live here need to have these sort of ecological refuges to sustain and survive into the future. Sage-grouse numbers continue to decline yield. Deer populations have been in decline for decades. Pronghorn continue to lose range, and the more and more that we eliminate and reduce their habitats, the more big landscapes like this are important. [...] Sustainability really needs to also include protecting the places that matter the most, especially to the species that don't have a voice to speak for themselves.

Lisa’s comment that the Caldera’s importance as an ecological refuge for a variety of species was reflected in several interviews, with a special focus on the Greater Sage-grouse. Jane expressed similar concern for fauna within the area:

> …habitat for Sage-grouse, […] pronghorn, all the desert species. It's a thriving area and particularly with Sage-grouse […]. To have a stronghold of habitat like that, that can be part of an effort to restore Sage-grouse in the great basin is critical to maintain.

Ideas behind biodiversity, ecological refuges, and “natural” spaces were associated with participant’s feelings towards the Caldera. Insights from these interviews revealed the McDermitt Caldera's significance as more than a landscape—many participants believe it is vital for ecological integrity and deserves preservation, particularly for species like the Greater Sage-grouse, a species who has faced decline at the hands of extractive projects throughout the West (Walker et al., 2007). This shared vision for the Caldera powerfully reflected perceptions behind "wild" spaces and supported arguments against transforming the landscape for extractive purposes.

6.4 Imaginaries around time, space, and potential futures for Oregon

Social imaginaries are rooted in political geography scholarship, providing a lens to investigate social understandings of places and their characteristics (Hommes et al., 2022). Social imaginaries shape how individuals perceive the world and guide their actions through interactions and shared narratives. These shared understandings, embedded in common knowledge and practices, define what is considered legitimate (Berry & Cohn, 2023). Additionally, imaginaries provide insight on concepts of the future. Oomen et al. (2022) defines imagined futures as "…the identification, creation and dissemination of images of the future shaping the possibility space for action, thus enacting relationships between past, present and future" (p. 252). Investigating social imaginaries relating to natural resources is effective in understanding shared narratives and bodies of knowledge regarding spatial and temporal aspects of resource use, and how members of society envision their contexts and futures (Barandiarán, 2019; Berry & Cohn, 2023; Carrasco et al., 2023). Ideas behind lithium mining within the state of Oregon brought up many diverging imaginaries among interview participants. These concepts centered around differing spatiotemporal understandings as they relate to landscape change and potential futures for the state of Oregon.

6.4.1 Differing ideas of time and space

Interviewees expressed different understandings of time in and the landscape's ability to recover from open-pit mining. Chris, a geologist involved in the permitting process, shared his understanding of time in relation to lithium mining:

> As a geologist, I'm very comfortable with the vastness of geological time, and if you're talking about right now in terms of exploration activity, there's a small amount of pad site development and a bit of new roads going in, et cetera, but the change is minimal. […] If you are further down the whole process and making the assumption that there is a mine permitted at some point, then there will be a change. I think the change is not as big as people have in mind. […] So over the mine life, 40 years there will be a footprint and then afterwards the change is really actually about how we envision reclamation and how creative we can be. […] I fundamentally believe that if reclamation is done correctly over a timescale, and we may not agree, everyone may not agree on what the timescale is, but that land will reclaim itself and we can help that or we can hinder that. And my role as a regulator is to make sure we help that.

Chris's belief in the reclamation process is defined by his understanding of time, while acknowledging that this perspective may be unique given his lens of geologic time. Chris notes that some "may not agree" with how change is understood within the reclamation process given differing timescales. Sam offered a countering perspective that was echoed by other interview participants who were against the idea of an open-pit mine in the Caldera: "As soon as you mine a place, you really destroy that ecosystem more or less permanently, or you alter it permanently, at least in many, many human lifetimes." In this statement, Sam's concept of permanent destruction is shaped by time, noting that one can experience this permanent destruction within their entire lifetime.

Competing perceptions of time and its implications for landscape recovery illuminate a fundamental debate within the interviews. Fent & Kojola (2020) explore the divergent spatio-temporalities within extractive landscapes, as these personal calculations of time are embedded in cultural understandings and ideologies. Chris's geological lens offers a view of change and reclamation as an extended, manageable process, while Sam's stance—shared by many participants—frames mining as an irrevocable disruption, defining it as "permanent" in terms of human lifespans. This aligns with Matt's earlier sentiment describing the permanence of landscape transformation at the hands of extraction when he said, "what's been lost is lost". Regarding the process of reclamation—wherein the land is rehabilitated— there is a tension regarding institutional accountability and the ability for the land to be "brought back". Research has shown that institutional trust is a common factor within public acceptance of renewable energy projects (Enserink et al., 2022) and that the belief in these systems can dictate a project's success or failure (Martiskainen & Sovacool, 2021).

6.4.2 Oregon's future

Given that lithium mining will be a new endeavor in the state of Oregon if the project moves forward, participants discussed the significance of open-pit lithium mining in the context of Oregon in particular, noting the larger implications that mining activities have for the state. These perceptions of the future were split: some highlighted positive aspects such as economic opportunities and resource independence, while others imagined that the adoption of mining activities foreshadowed a future of further extraction. Jim, a mining representative with an active lithium claim within the northern Caldera, highlighted the potential for prosperity from mining and benefits to local communities. Jim stated:

> People don't necessarily acknowledge that some of the great towns or cities of the world, they've forgotten that they were developed on the back of successful mining operations that funded the development of all those facilities. […] I talk to people, I try and encourage them to think about the future which is clean and green and we've dramatically reduced our emissions and that they as a community, they can be a part of achieving that vision and a very important part. […] The benefit of being able to tap into local communities who can directly benefit and get jobs and don't need to, as I said earlier, send their kids or partners to more remote parts of the world, the country, or the state to go and work and get jobs.

Jim’s reflection on the positive histories of mining, and how successful mining operations have been foundational to concepts of growth and development. Moreover, Jim highlighted the imaginaries of a “future which is clean and green” and the benefits to local communities getting who participate in the extractive transition. This sentiment of prosperity and opportunity is shared by Felix:

> I think that extraction in Oregon would present the idea that Oregon gets to participate in this transition out of fossil fuel dependency, that Oregon gets to participate in a solution for future climate management and transportation change. […] Pretty exciting stuff too, […] the idea that Oregon would enjoy participating in a new technology.

This notion of opportunity and prosperity was also noted by Chris when he said: “I think from a political perspective, over a lifetime where people can make careers, this looks like economic opportunity and an opportunity to put something into the market that helps the entire climate change agenda by being able to materially change a form of transport.” Alex, a Malheur County Commissioner also explored ideas behind economic benefits, while highlighting the benefits of resource independence:

> Right now China's got what, 90% of the market? So, we are totally dependent on them. And as we transition forward, that's not going to improve our position if we don't figure out how to produce our own. […] That'd be another positive, I think because of the amount of jobs that it creates. […] I'm assuming that the economic boom would be something we probably couldn't even realize or even visualize it until it happened.[…] You'll get a lot of jobs to Malheur County short term, long term, I don't know what the impact will be.

Alex appears to be invested in the idea of local lithium extraction but provides some skepticism regarding the longevity of job opportunities associated with mining operations.

Apart from the perceived economic benefits that this new industry will bring, many participants mentioned non-lithium mining operations in other parts of the state as a sign of things to come. Specifically, the Grassy Mountain Mine outside of Vale, Oregon, was cited in several interviews. The Grassy Mountain Mine holds significance in that it would be the first chemical treatment mine within the state of Oregon. With the proposed Grassy Mountain Mine, gold and silver ore would be extracted and processed through an on-site cyanide leaching facility. Because of the multi-agency permitting process involved in the consolidated permit that is needed for chemical treatment mining, alongside high environmental standards mandated by the state, no mining operations within the state use chemical treatment methods. Katie reflected on the Grassy Mountain Mine during our interview: “I think we'll see more mines. I think the Grassy Mountain Mine might be the tip of the iceberg.” Alex provided insight on this as well: “If it ever gets in full production, there's 16 others available right next to it.” Jim also emphasized the symbolism of the Grassy Mountain’s progress: “We are also watching how things unfold up north […] This could mean a lot for our operation.” Katie, Alex, and Jim all express the importance of the Grassy Mountain Mine's progress in diverging ways while connecting it to ideas about the McDermitt Caldera. Katie expressed concern for the mine, citing that it could be a harbinger of things to come. Alex noted that should the mine succeed, there are several other operations waiting to move forward. Jim highlighted how the mine's progress could have serious implications for his own mining operation. The visions associated with mining the McDermitt Caldera demonstrate diverse perceptions on time, place, and the future. Advocates like Jim see lithium mining as a path to local growth, green jobs, and actions towards climate change mitigation. In contrast, others see mining the area as an irreversible environmental cost and connect the progress of other mines within the state as the beginning of a new extractive era.

6.5 Summary

In this study, interview participants reflected on issues of renewable energy technologies and the effects of their production, in particular the proposed open-pit lithium mining in the McDermitt Caldera. Several contrasting narratives emerged. On the one hand, a few participants expressed optimism for Oregon's potential involvement in what they saw as a more sustainable future powered by green energy. Job creation, economic opportunity, belief in the remediation process, and the need to reduce fossil fuel use were at the center of this narrative. Contrastingly, many participants voiced concerns about what they perceived as irreversible damage to the Caldera's unique ecosystems. From these concerns, long-term ecological costs were a central component, suggesting that the impact on natural habitats, water resources, and biodiversity could outweigh the short-term gains. Additionally, some participants expressed skepticism about the clean energy narrative, questioning whether the transition to renewable sources like lithium truly addresses underlying issues of consumption and environmental degradation. Through these divergent perspectives, the McDermitt Caldera can be better understood as a contested space. These concepts will be further explored in the discussion section.

7. Spatial Analysis Methods

Ideas surrounding ecosystem health, habitat, and local fauna within the McDermitt Caldera were a frequent topic in the interviews that I conducted. To explore the spatial dimensions of these topics, in addition to highlighting the physical dimensions of potential open-pit mining within this region, I conducted an overlay analysis in ArcGIS Pro using sensitive species identified by the Oregon Conservation Strategy Species within the Northern Basin and Range ecoregion. The Oregon Conservation Strategy is a state-wide strategy for conserving fish and wildlife, run by the Oregon Department of Fish and Wildlife (ODFW). The stated goals of the Conservation Strategy are to 1) maintain healthy fish and wildlife populations by maintaining and restoring functioning habitats, 2) prevent declines of at-risk species, and 3) reverse declines in these resources where possible (Oregon Conservation Strategy, 2016). In the Conservation Strategy, Strategy Habitats and Strategy Species are identified based on conservation concern. This resource was chosen for its data availability at both state and ecoregion scales.

The overlay analysis was performed to understand how the habitats of species of high conservation importance overlap with potential lithium mining operations.

From my semi-structured interviews, there were perceptions that habitat existing within proximity to mining operations would be eliminated were common. It has been proven that human-caused disturbances, such as mining, road construction, and other dramatic land-use changes cause habitat fragmentation that can lead to species decline (Brooke et al., 2008; Zhuo et al., 2022). Using the Conservation Strategy website, I selected 33 Strategy Species that were identified for the Northern Basin and Range ecoregion (see Table 3). This included amphibian, bird and mammal species. Fish, plant and invertebrate species were not chosen due to a lack of consistent habitat data. Additionally, there were no reptile species of conservation concern within this ecoregion.

Table 3: Conservation Strategy Species for the Northern Basin and Range Ecoregion. Fish, plant and invertebrate species were not chosen due to a lack of consistent data.

Species Common Name	Latin Name	Conservation Status
American Pika	*Ochotona princeps*	Sensitive
American White Pelican	*Pelecanus erythrorhynchos*	Sensitive
Black-necked Stilt	*Himantopus mexicanus*	Sensitive
Bobolink	*Dolichonyx oryzivorus*	Sensitive
Burrowing Owl	*Athene cunicularia*	Sensitive
California Myotis	*Myotis californicus*	Sensitive
Caspian Tern	*Hydroprogne caspia*	Sensitive
Columbia Spotted Frog	*Rana luteiventris*	Sensitive
Ferruginous Hawk	*Buteo regalis*	Sensitive
Franklin's Gull	*Leucophaeus pipixcan*	Sensitive
Fringed Myotis	*Myotis thysanodes*	Sensitive
Gray Wolf	*Canis lupus*	Federal ESA listing
Greater Sage-Grouse	*Centrocercus urophasianus*	Sensitive, Federal species of concern
Greater Sandhill Crane	*Antigone canadensis tabida*	Sensitive
Hoary Bat	*Lasiurus cinereus*	Sensitive, Federal species of concern
Juniper Titmouse	*Baeolophus ridgwayi*	Sensitive
Kit Fox	*Vulpes macrotis*	Threatened
Long-billed Curlew	*Numenius americanus*	Sensitive
Long-legged Myotis	*Myotis volans*	Sensitive, Federal species of concern
Mountain Quail	*Oreortyx pictus*	Sensitive, Federal species of concern
Pallid Bat	*Antrozous pallidus*	Sensitive, Federal species of concern
Peregrine Falcon (American)	*Falco peregrinus anatum*	Sensitive
Pygmy Rabbit	*Brachylagus idahoensis*	Sensitive, Federal species of concern
Silver-haired Bat	*Lasionycteris noctivagans*	Sensitive, Federal species of concern
Snowy Egret	*Egretta thula*	Sensitive
Spotted Bat	*Euderma maculatum*	Sensitive, Federal species of concern
Swainson’s Hawk	*Buteo swainsoni*	Sensitive
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Sensitive, Federal species of concern
Trumpeter Swan	*Cygnus buccinator*	Sensitive
Western Snowy Plover	*Charadrius nivosus nivosus*	Threatened, Federal Threatened listing (Pacific Coast population)
Western Toad	*Anaxyrus boreas*	Sensitive
White-tailed Jackrabbit	*Lepus townsendii*	Sensitive
Willow Flycatcher	*Empidonax traillii*	Sensitive, Federal species of concern

Habitat range data for each species was available as raster data through the Conservation Strategy website, which was provided by USGS GAP (Gap Analysis Project) data. Polygon footprints of the mining operations were provided by the GIS team at ONDA, who digitized mining boundaries from a combination of sources, many of which were collected from lithium producers and FOIA requests to state agencies involved in the permitting process. Polygon data of Oregon's ecoregions was downloaded from the ODFW website.

Table 4: Data sources used for overlay analysis.

Data	Type	Source
Oregon Conservation Strategy Species for the Northern Basin and Range	Species list	Oregon Conservation Strategy https://www.oregonconservationstrategy.org/ecoregion/northern-basin-and-range/
Habitat range data	Raster package	USGS Gap Analysis Species Data https://gapanalysis.usgs.gov/apps/species-data-download/
Mining claims	Shapefile	Oregon Natural Desert Association (ONDA) (Personal communication)
Oregon Ecoregions	Shapefile	Oregon Department of Fish and Wildlife https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&-XMLname=1163.xml

To understand how potential mining operations interact with habitats of the Strategy Species, the overlay analysis took a two-step approach. First, species whose habitat overlapped with mine operations were identified. Second, if there was overlap, the total area of habitat that overlapped with mining operations was calculated. Furthermore, a percentage of overlapped habitat was calculated based off the total area that overlapped with mining claims compared to the total area within the Northern Basin and Range ecoregion. This percentage represents habitat that could be affected by mining operations. Below is a description of the methods used within the overlay analysis.

7.1 Strategy Species Overlay Analysis

Following the methods used by Parker et al. (2022), a 2-mile buffer was added to each mining claim then dissolved into a single feature, as this is meant to capture the potential spatial extent of impacts beyond the administrative boundaries of the claim (this could include road construction, powerlines, noise, etc). The project claim represents the actual mining claim, while the project site embodies the 2-mile buffer that is added to the project claim (see Figure 14). The project site was used in the overlay analysis. Because this analysis is solely for the state of Oregon, I clipped the mining shapefile to the state of Oregon and claims that are in Nevada are not considered within this analysis. With the 2-mile buffer, the total area of the project site is 112.17 square statute miles.

It is worth noting that the mining claims are not contiguous with the operational area of boundaries of mines, or the area impacted by a mine. Due to the early nature of potential operations, this is a speculative study. The 2-mile buffer that is applied can account for certain potential impacts beyond administrative boundaries, however, impacts such as groundwater and surface water pollution, soil erosion and vegetation loss, can extend far beyond the spatial limits that were used in this study.

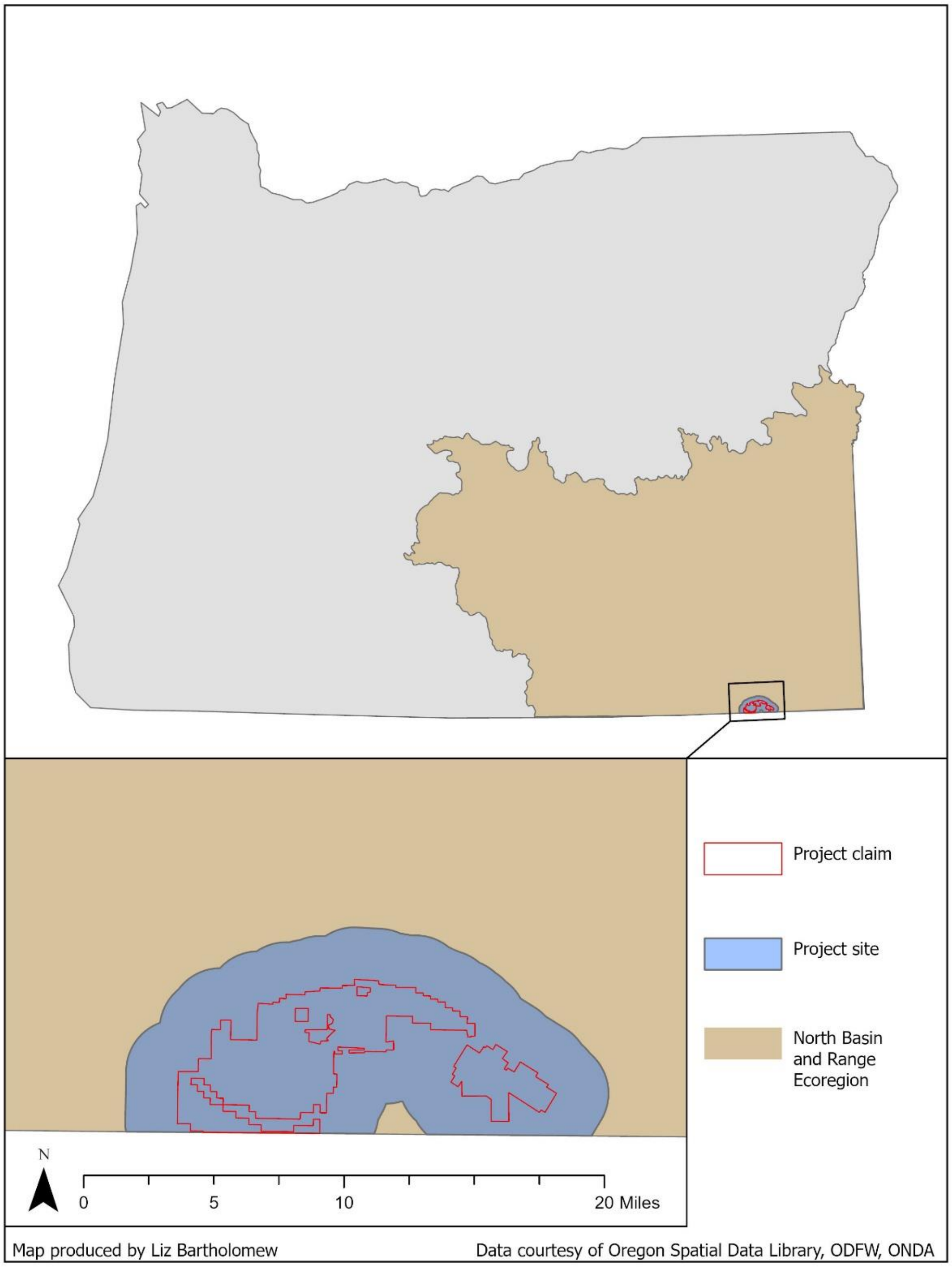

Figure 14: Project claim with a 2-mile buffer, represented as the project site. Adopted from the Parker et al. (2022) analysis of lithium mining claims within select areas of the United States.

Using the data obtained from the 33 Strategy Species, I created an Excel spreadsheet that included the common and Latin names of species, in addition to their conservation listing (see Table 3). As I proceeded through the overlay analysis, the spreadsheet was populated to reflect whether there was habitat overlap, and if yes, how much habitat area was present in the Northern Basin and Range ecoregion and how much habitat overlapped with mining operations. Area was calculated in square statute miles.

For the first part of the overlay analysis, I used the habitat raster data to identify the habitats of species that overlapped with mining operations. For species whose habitat did not overlap, there was no further analysis. For species that did have overlap, the second half of the analysis was carried out (see Figure 15 for analysis workflow). To understand the total area for each species within the Northern Basin and Range ecoregion, the habitat raster data was converted to polygon features using the Convert Raster to Polygon tool. When the raster data was vectorized to the polygon feature this created several polygons (often thousands). To simplify the dataset, I used the Dissolve tool for all the polygons so the habitat would operate as a single multi-part feature. This polygon feature that was created was then clipped to the Northern Basin and Range ecoregion polygon, and the area was calculated using the Calculate Geometry feature in the attribute table of the habitat range. Next, I used the Count Overlapping Features tool to delineate where the two features overlapped. The two input features were the buffered mining claim (the project site) and the clipped and dissolved habitat polygon feature. The tool calculated the amount of overlap between the two features which created a new polygon feature with an attribute table. Using the

Calculate Geometry feature in the attribute table, the square mileage of overlap was calculated. The square mileage of Northern Basin and Range habitat and the square mileage of habitat that overlapped with the project site was documented in the Excel spreadsheet, and the percentage of habitat that overlapped with mining claims was calculated in Excel using the following equation:

$$Percent\ habitat\ overlap\ = \left(\frac{Habitat\ overlap}{Northern\ Basin\ and\ Range\ habitat}\right) \times 100$$

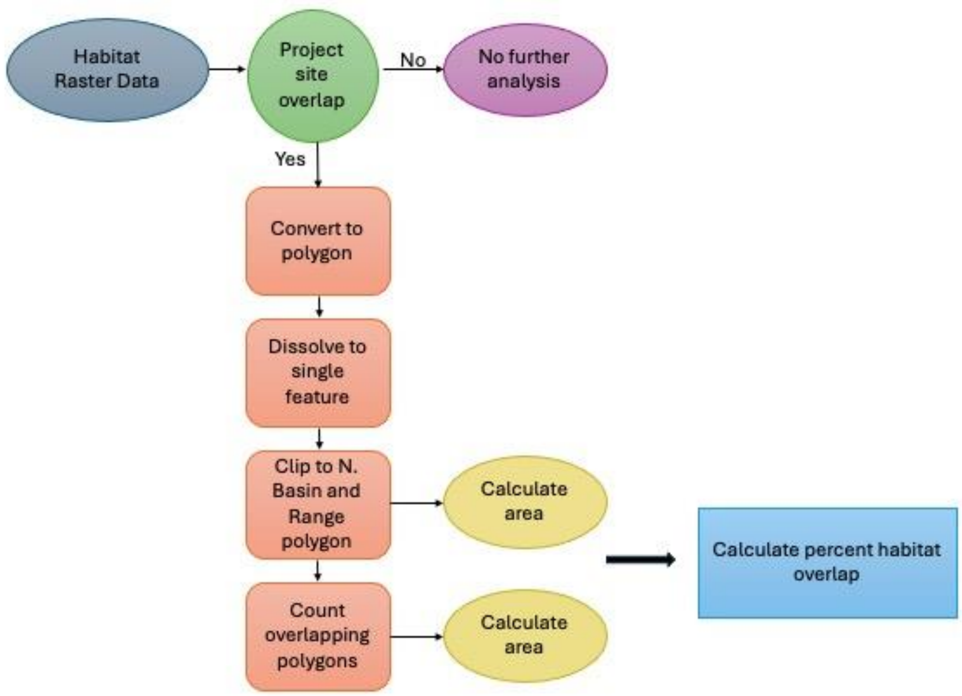

Figure 15: Overlay analysis workflow.

8. Spatial Analysis Results

Of the 33 habitat ranges of Strategy Species within the Northern Basin and Range ecoregion that were used in this analysis, 25 habitats overlapped with the project site, accounting for 75% of the total analyzed species. Of these, nine species have a conservation status of federal Species of Concern and one species, the Kit Fox, is state listed as Threatened. The five species with the highest percentage of habitat overlap were the Franklin's Gull (*Leucophaeus pipixcan*), Mountain Quail (*Oreortyx pictus*), Pygmy Rabbit (*Brachylagus idahoensis*), Kit Fox (*Vulpes macrotis*) and Greater Sage-grouse (*Centrocercus urophasianus*). Figures 16-20 show habitat range of the five species within the Northern Basin and Range and overlap with mining operations. Table 5 shows each species' habitat range in square miles within the Northern Basin and Range, the square mileage of overlap, and the percent of overlap.

Species Common Name	Latin Name	Oregon Conservation Status	Federal Status	Sq. Miles N. Basin and Range	Sq. Miles Overlap Area	Percent Habitat Overlap
Franklin's Gull	*Leucophaeus pipixcan*	Sensitive		1.64	0.47	28.84
Mountain Quail	*Oreortyx pictus*	Sensitive	Species of Concern	6.65	0.25	3.73
Pygmy Rabbit	*Brachylagus idahoensis*	Sensitive	Species of Concern	11316.34	101.58	0.90
Kit Fox	*Vulpes macrotis*	Threatened		12092.33	99.43	0.82
Greater Sage-Grouse	*Centrocercus urophasianus*	Sensitive	Species of Concern	14533.94	101.54	0.70
Spotted Bat	*Euderma maculatum*	Sensitive	Species of Concern	14418.83	87.55	0.61
Long-legged Myotis	*Myotis volans*	Sensitive	Species of Concern	18517.98	102.57	0.55
Fringed Myotis	*Myotis thysanodes*	Sensitive		16615.21	87.62	0.53
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Sensitive	Species of Concern	20522.55	106.84	0.52
Burrowing Owl	*Athene cunicularia*	Sensitive		21551.01	109.03	0.51
White-tailed Jackrabbit	*Lepus townsendii*	Sensitive		22126.87	108.71	0.49
Ferruginous Hawk	*Buteo regalis*	Sensitive		22564.10	110.67	0.49
Swainson’s Hawk	*Buteo swainsoni*	Sensitive		22984.79	110.57	0.48
Pallid Bat	*Antrozous pallidus*	Sensitive	Species of Concern	23693.39	111.62	0.47
Peregrine Falcon (American)	*Falco peregrinus anatum*	Sensitive		20615.67	92.05	0.45
Long-billed Curlew	*Numenius americanus*	Sensitive		15235.14	57.41	0.38
Hoary Bat	*Lasiurus cinereus*	Sensitive	Species of Concern	8969.26	33.57	0.37
Juniper Titmouse	*Baeolophus ridgwayi*	Sensitive		2218.29	7.28	0.33
American Pika	*Ochotona princeps*	Sensitive		308.98	0.71	0.23
Silver-haired Bat	*Lasionycteris noctivagans*	Sensitive	Species of Concern	1722.41	2.73	0.16
Black-necked Stilt	*Himantopus mexicanus*	Sensitive		844.50	1.17	0.14
Snowy Egret	*Egretta thula*	Sensitive		986.44	1.30	0.13
California Myotis	*Myotis californicus*	Sensitive		23438.40	26.89	0.11
Western Toad	*Anaxyrus boreas*	Sensitive		97.83	0.06	0.07
Columbia Spotted Frog	*Rana luteiventris*	Sensitive		102.96	0.01	0.00

Table 5: Results of overlay analysis organized from highest to lowest percentage of habitat overlap.

The habitat of the Franklin's Gull had the largest area of overlap and simultaneously the smallest habitat range within the North Basin and Range at 1.64 square miles. Within this range, 0.47 square miles fell within the mining project site, which encapsulates 28.84% of the species' habitat (see Figure 16) within the Northern Basin and Range Ecoregion. Franklin's Gulls breed in small, scattered colonies across Oregon, relying on large marshes where they nest on floating vegetation in water deep enough to deter predators. Their specialized nesting requirements make them highly susceptible to changes in water levels and sensitive to human disturbances at their breeding sites (Oregon Conservation Strategy, 2016). Franklin's Gull range extends from South America to Northern Canada, with the western-most extent of their range extending into eastern Oregon. Due to this large geographic range, a small portion is represented in the state of Oregon. When analyzed within the context of overlapping with mining operations in the Northern Basin and Range, the low overall area in the state is represented as a high percentage.

Mountain Quail habitat range was limited to 6.65 square miles within the Northern Basin and Range, with 3.73% of this habitat overlapping with the project site (see Figure 17). Mountain Quails are currently listed as a Federal Species of Concern due to habitat loss and degradation (U.S. Fish & Wildlife, 2003). In Oregon, Mountain Quails occupy a wide array of habitats throughout the state, primarily in the Cascade Range. East of the cascades, they inhabit shrubby riparian areas close to grassy uplands. In the Northern Basin and Range, populations have experienced decline due to habitat degradation and loss (Cornell Lab of Ornithology, 2024; Oregon Conservation Strategy. 2016).

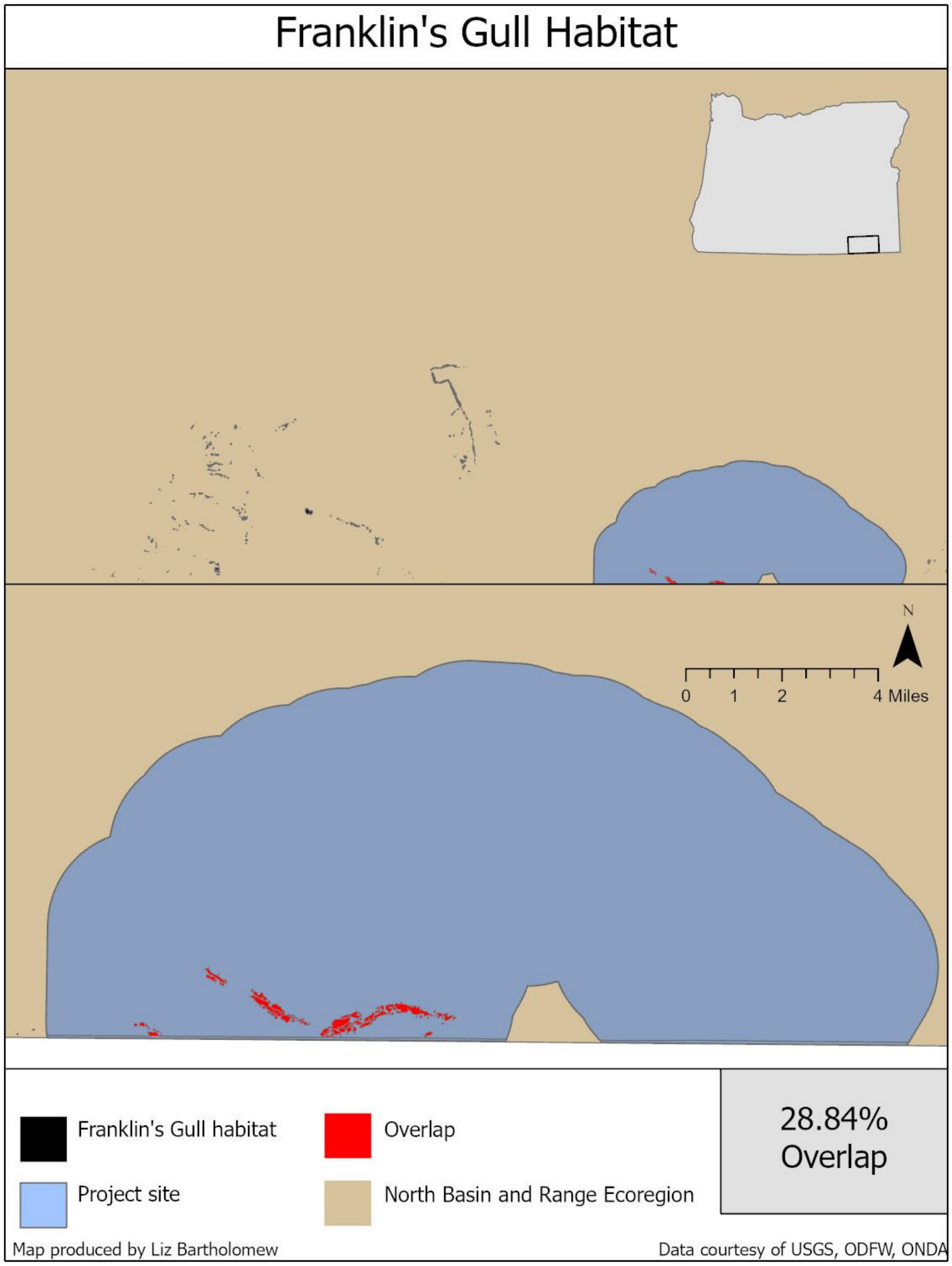

Figure 16: Map of Franklin's Gull habitat distribution within the Northern Basin and Range ecoregion. Of the 1.64 sq. miles of habitat within the Northern Basin and Range ecoregion, 0.47 sq. miles overlapped with the project site. This represented the highest percentage of overlap in this analysis.

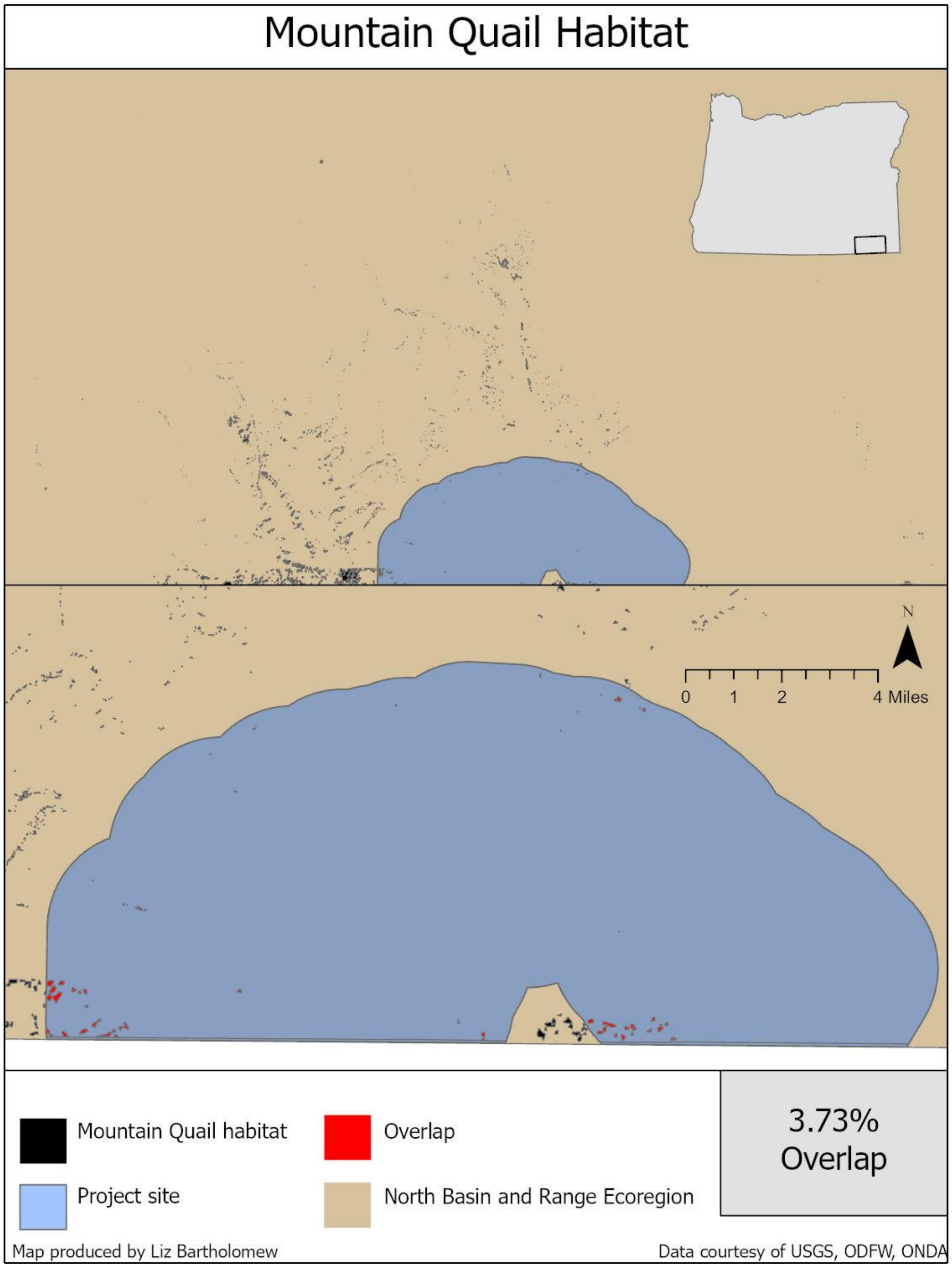

Figure 17: Map of Mountain Quail habitat distribution in the Northern Basin and Range ecoregion. Of the 6.65 sq. miles in the Northern Basin and Range ecoregion, 0.25 sq. miles overlapped with the project site.

The remaining species' habitat ranges that were analyzed had large habitat ranges within the Northern Basin and Range ecoregion. Many had habitat overlap close to the maximum extent of the project site (112.17 square miles), this resulted in high values relating to the square mileage of overlap and low percentages of overall habitat overlap. This meant that close to 100% of the area of the potential mining operations intersected with the habitats of most species analyzed. Figures 18-20 demonstrate the expansive range, high overlap, and lower (<1.0) percentages. These figures also represent the species' habitat ranges with the third, fourth, and fifth highest percentages of overlap.

Pygmy rabbit habitat covered 11316.34 square miles within the Northern Basin and Range ecoregion, 101.58 of which overlapped with the project site (see Figure 18). Pygmy rabbits are federally listed as a Species of Concern, largely due to habitat degradation and fragmentation from wildfires and disease (U.S. Fish and Wildlife Service, 2024). Pygmy rabbits rely on tall, dense clumps of basin big sagebrush, requiring deep, loose soils for burrowing and native grasses for foraging during summer. In Oregon, populations are isolated and prone to local declines due to habitat loss, and their already restricted dispersal capabilities are further hindered by roads and cleared areas. Conservation efforts prioritize maintaining basin sagebrush habitats (Oregon Conservation Strategy, 2016).

Kit fox habitat covered 12092.33 square miles within the Northern Basin and Range ecoregion. Of this total, 99.43 square miles overlapped with the project site (see Figure 19). Kit foxes are listed as Threatened within the state, a listing which recognizes a species' risk for extinction (Oregon Department of Fish and Wildlife, 2020c). They occupy desert and semi-arid regions. Little is known about the northern extent of their habitat range, which includes Oregon. Population declines in Kit foxes have been tied to habitat loss, degradation, predation, and anthropogenic factors (Oregon Conservation Strategy, 2016).

The Greater Sage-grouse's habitat range represented the fifth highest percentage of overlap with the project site (see Figure 20). Of the total 14533.94 square miles that cover the Northern Basin and Range ecoregion, 101.54 had overlap with the project site. Like the Kit fox and the Mountain Quail, the Greater Sage-grouse is a federal Species of Concern, having experienced national population decline from habitat degradation, fragmentation, and loss (Braun, 1988; Davies et al., 2011; Lucas & Stellberg, 2021; Walker et al., 2008). Sage-grouse rely on expansive sagebrush ecosystems, which include suitable sagebrush habitat for lekking sites that are visited annually, ensuring a future population of the species (Oregon Conservation Strategy, 2016). Their conservation status and relationship to the McDermitt Caldera were central topics in the interviews that I conducted and are further explored in the discussion section.

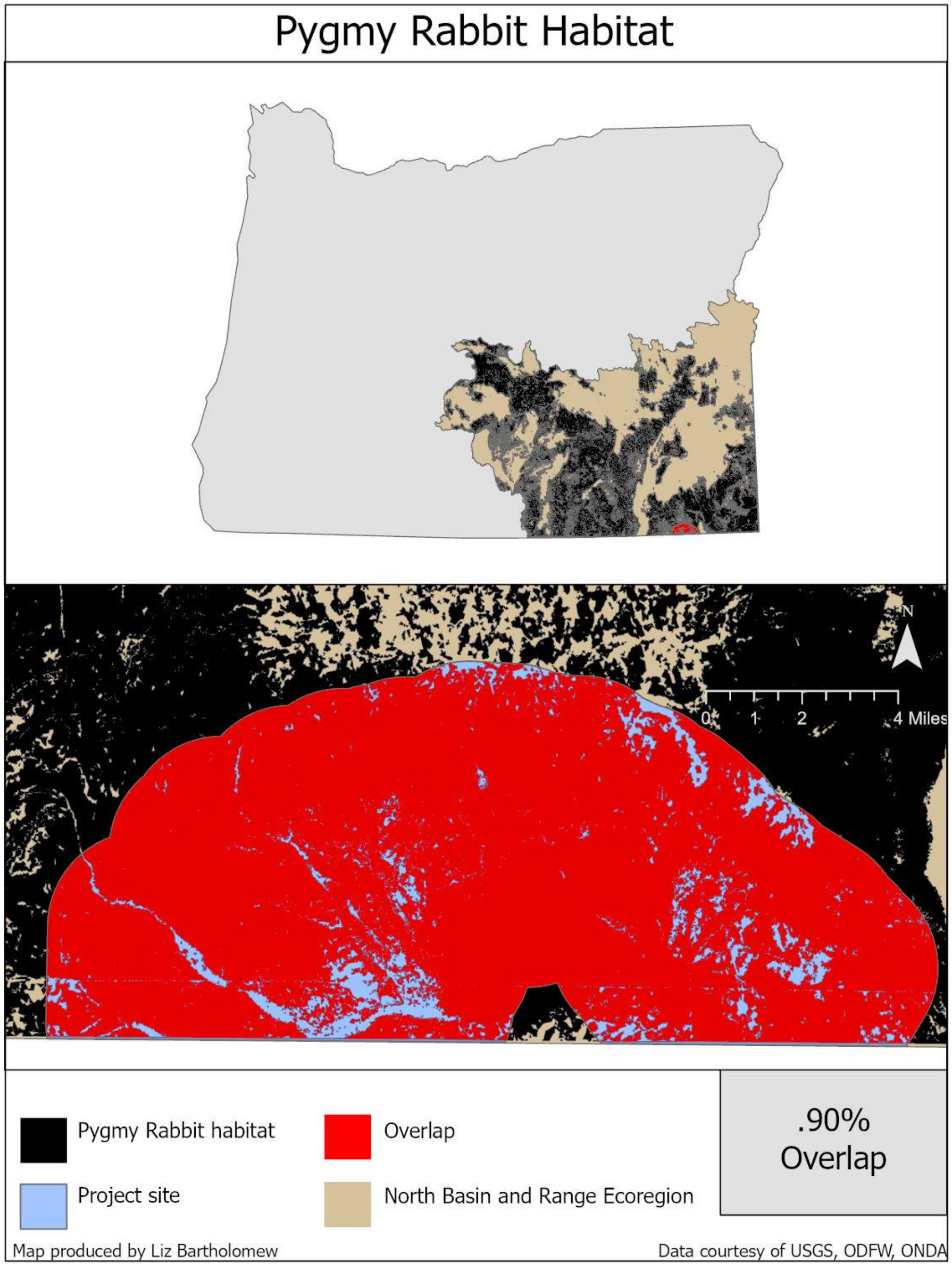

Figure 18: Map of Pygmy Rabbit habitat distribution in the Northern Basin and Range ecoregion. Of the 11316.34 sq. miles in the Northern Basin and Range ecoregion, 101.58 sq. miles overlapped with the project site.

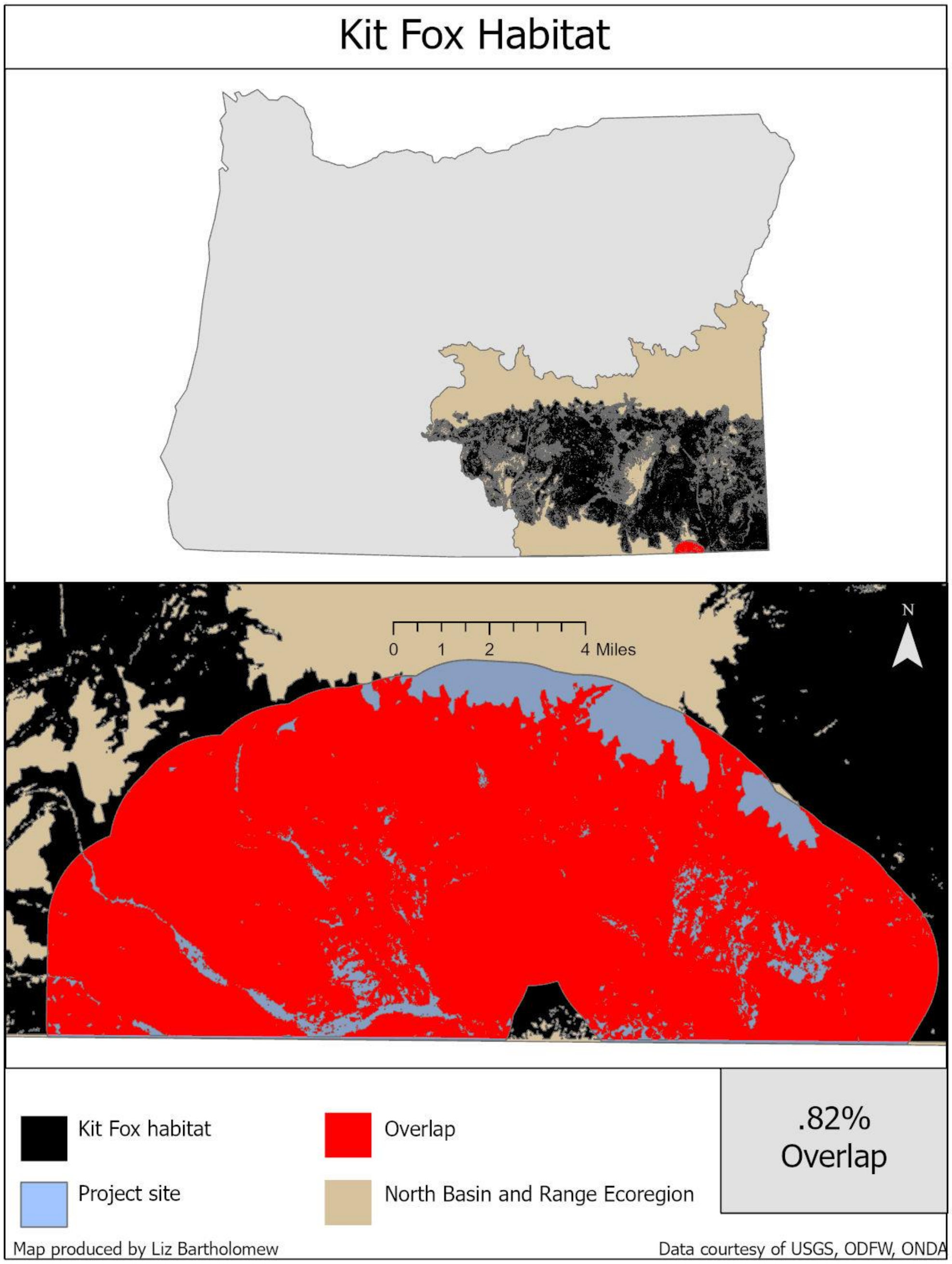

Figure 19: Map of Kit Fox habitat distribution in the Northern Basin and Range ecoregion. Of the 12092.33 sq. miles in the Northern Basin and Range ecoregion, 99.43 sq. miles overlapped with the project site.

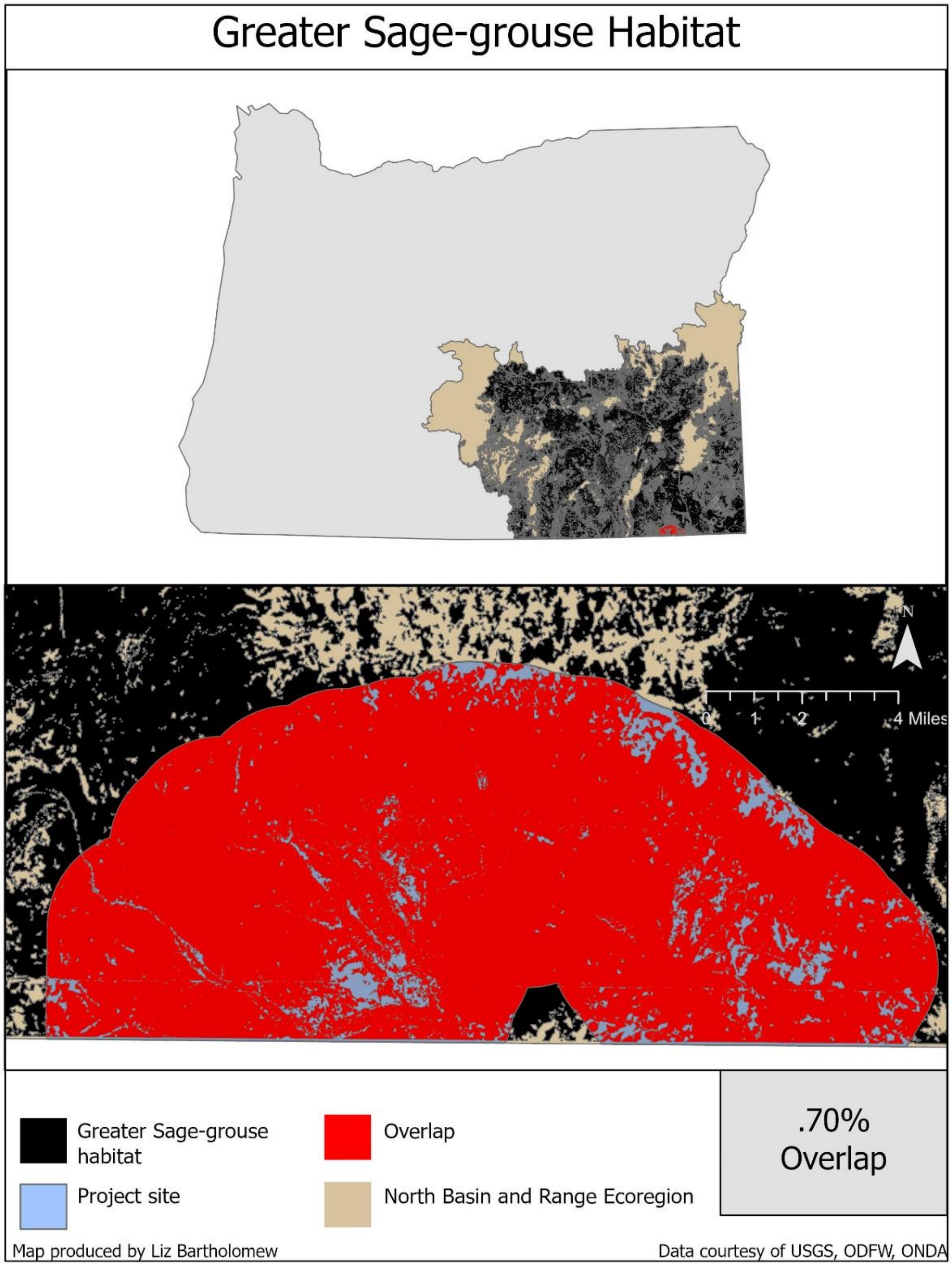

Figure 20: Map of Greater Sage-grouse habitat distribution in the Northern Basin and Range ecoregion. Of the 14533.94 sq. miles in the Northern Basin and Range ecoregion, 101.54 sq. miles overlapped with the project site.

8.1 Summary

In this overlay analysis, I compared the habitat ranges of state-designated sensitive species, identified by the Oregon Conservation Strategy's list of Strategy Species. My investigation was limited to the Northern Basin and Range ecoregion, as this ecoregion 1) is representative of the McDermitt Caldera's ecosystem writ large, and 2) provided guidance for identifying species that rely on this habitat. I followed the analysis methods used by Parker et al. (2022), by applying a 2-mile buffer to each mining claim to account for the extent of impacts beyond the claim boundaries. A total of 33 Strategy Species were selected for this analysis, due to data availability and continuity. Of these 33 species, 25 had habitat overlap with mining operations, which translates to 75% of the total potentially being affected by mining activities. The broader implications of these findings will be explored in the discussion section.

9. Discussion

The goal of this research was to examine how people perceive the impacts of open-pit lithium mining within the McDermitt Caldera, Oregon. Additionally, this study investigated the spatial dimensions of these transformations on habitats of sensitive species within the Northern Basin and Range ecoregion. The study was divided into two phases. First, I used qualitative methods to understand the narratives and perceptions surrounding potential operations in the area. The central questions for my qualitative analysis were *(1) How do actors involved in Oregon's portion of the McDermitt Caldera perceive lithium as a strategy for decarbonizing?* and *(2) How do these perceptions underscore support for or opposition to open-pit lithium mining in the McDermitt Caldera, Oregon?*

The findings from my semi-structured interviews informed the subsequent spatial analysis, bridging emotional and ecological viewpoints with geospatial data. Using ArcGIS Pro, I analyzed how proposed mining operations spatially coincide with species of high conservation value within Oregon's Basin and Range ecoregion. In this second phase of the research, I asked: *(3) How does the spatial extent of mining operations interact with habitats of sensitive species within Oregon's Northern Basin and Range ecoregion?*

This research revealed diverging perceptions of open-pit lithium mining within the region, showing that there is no shared consensus, however, there are certain common narratives of support of or opposition to mining activities. In the following discussion I examine the results of my interview data as well as my spatial analysis.

9.1 Competing Ideas of Landscape

Open-pit lithium mining in the McDermitt Caldera demonstrates that the idea of a landscape can take on distinct meanings to different people. Bridge et al. (2013) define a landscape as an "…assemblage of natural and cultural features across a broad space" (p. 335) that take on unique meanings to individuals. It is within these perceptions of landscape that values, belief systems, and place attachments are embedded. Narratives of opposition surrounding open-pit lithium mining in the McDermitt Caldera shared a common belief that the Caldera is a landscape distinct for its intact ecology and ability to support sensitive wildlife and is therefore deserving of preservation. These concepts shed light on the emotions and place attachments that support values relating to the McDermitt Caldera.

Previous research has shown that values and emotions can be the driving oppositional factor for landscape transformations associated with renewable energy projects (Cass & Walker, 2009; Martiskainen & Sovacool, 2021; Pavlowsky et al., 2023), as place-attachment and connection to a landscape requires an emotional bond (Hidalgo & Hernandez, 2001). This study confirmed the importance of emotional connections: participants who felt connected to the Caldera saw open-pit lithium mining as a direct threat to the health of the landscape and its ability to act as a refuge for non-human life, often stating that the land will be "lost" should mining operations move forward. Through this sense of loss, feelings surrounding protection and preservation arose. Preservation for the sake of the ecological integrity within the Caldera aligns with what Jenkins (2016) refers to as "biocentric values", that is —

preserving nature for nature's sake, outside of human gain. Biocentric values are common in oppositional discourse surrounding large-scale renewable energy projects, as past research has shown environmental degradation associated with certain projects (Gasparatos et al., 2017; Gibson et al., 2017; Gutiérrez et al., 2022; Lauer et al., 2023;).

Interview participants who were less opposed to, or in favor of mining operations envisioned the landscape as an economic opportunity and a mechanism to achieve sustainability goals. Through this anthropocentric lens, the landscape is a host for natural resources, which function to serve human needs. This in turn converts the natural landscape into a material landscape (Bridge 2009; Bridge et al., 2013; Fent & Kojola, 2020). Nadaï & Van Der Horst, (2010), attest that these material landscapes "…draw attention and uses to landscapes that were not coveted before...lead[ing] to the formation of new landscapes" (p. 145). This is especially true for the McDermitt Caldera, as the rapid popularity of lithium paired with its abundance in this region has changed the landscape to many.

In this study, anthropocentric values that supported lithium extraction aligned with future imaginaries, which can be used to examine expectations, potential paths of development, and processes of decision-making (Beckert, 2016; Carrasco et al., 2023). Imaginaries of prosperity and economic opportunities related to mining were at the center of discourses in support of the mining operations. Many felt that the economic benefits were the highest priority, especially at the county level, given that Malheur County has the highest poverty rate in the state of Oregon (U.S. Census Bureau, 2020). Recent research by Enserink et al. (2022) supports this idea, as local economic benefits were the most frequently mentioned factor within acceptance studies of renewable energy technologies.

The notion that extracting lithium in the McDermitt Caldera will build a pathway to low-carbon technologies that will mitigate, or 'fix' the effects of climate change resonates with the concept of socio-technical fixes, which is rooted in the idea that the benefits of technology have no limits and the risks are manageable (Barandiarán, 2019; Jassanoff & Kim, 2013). Within this framework, the extraction of lithium is both a strategic resource and an opportunity for technologic innovation. Certain participants felt that not only would an open-pit lithium mine in the McDermitt Caldera advance climate goals at the global scale, but there was also symbolic value that the state of Oregon would be involved in this opportunity for innovation. It was within these ideas of a socio-technical fix that there was limited to no mention of environmental concerns, solely innovation and opportunity. Among the perceptions that were revealed in this study, anthropocentric values, which largely coalesced around economics and socio-technical fixes directly conflicted with biocentric values.

9.2 Insufficient Environmental Knowledge

In this study, participants frequently raised issues about knowledge gaps related to environmental management and decision making. Many associated these knowledge gaps with obfuscated information from mining companies and public agencies, administrative boundaries between Oregon and Nevada creating blind spots, and the remoteness of the McDermitt Caldera as being a place of “low interest” for the state. Kroepsch & Clifford (2022) refer to such places as “inscrutable”, as they embody “…a space that is made difficult to know by an interplay of biophysical, epistemic, and political economic factors, and whose unintelligibility poses serious consequences for environmental politics and everyday life” (p. 172). This concept is widely recognized within the lens of political ecology, as resource management is shaped by environmental knowledge and reflects the power dynamics that are involved in the decision-making process (Benson, 2021; Robbins, 2000; Robbins, 2012; Van der Molen, 2018). Although interviewees recognized an absence of local environmental knowledge from land managers within the area, they also largely expected that mining operations will continue forward. Kinchy (2020) argues that ignorance relating to environmental knowledge of a landscape, or baseline data, is often advantageous to extractive entities, as there can be no proof of environmental harm after conditions have changed because there is no record of pre-extraction conditions. Martin (2021) echoes this issue with environmental and resource managers, stating that “…pragmatic choices around day-to-day practices, technologies employed, and where time and attention get[s] spent, agents appear to collect less or more ambiguous information […] resulting in a lack of knowledge and subsequent problems for on-the-ground management” (p. 195). McGoey (2012) names this phenomenon “strategic ignorance”, which mobilizes control of resources and denies liability. Several participants criticized the advancement of mining operations without baseline knowledge of the area, openly questioning the ability to track environmental damage from mining activities if there is limited preexisting data.

Central to knowledge politics within the McDermitt Caldera was water, both its use from mining operations and the availability of groundwater (from which the mining companies would likely be pulling from). Limited groundwater knowledge and the management practices that follow has been a growing body of research (Anderson & Cantor, 2024; Birkenholtz, 2008; Budds, 2009; Walsh, 2022). Despite the reliance on groundwater in most parts of the world, overexploitation and under-knowing the complexity of the hydrologic systems where extraction is occurring is a pervasive issue. Budds (2009) argues that the contradictions of high-use and low-knowledge is inherently political given the social and environmental consequences that follow. Additionally, Budds argues that this is a way to "…exert control over water" (p. 428). From the regulatory perspective, there was an acknowledged lack of information relating to the baseline conditions of the McDermitt Caldera's hydrology, specifically knowledge of groundwater availability and the surface-to-groundwater connectivity. Studies have shown that excessive groundwater use within the context of lithium extraction has altered surface water, with cascading effects to local flora and fauna (Gutiérrez et al, 2022; Liu et al., 2019). Given the early nature of mining operations in Oregon's section of the Caldera, Thacker Pass serves as a template for how mining could look. It is estimated that operations at Thacker Pass will use more than 1.6 billion gallons of groundwater a year (Blair et al., 2024). Concerns relating to water consumption and water contamination were echoed by interview participants who were against mining operations, with an emphasis on the importance of water within this ecoregion.

Due to the Caldera's presence within two states, with a majority in Nevada, certain state employees identified insufficient data in the northern section of the Caldera, citing that due to these administrative boundaries and the multiple agencies overlapping within the area, there was a clear lack of communication. There was a sentiment of confusion from certain state employees, asking aloud which agency was responsible for what. Milman et al. (2020) contend that transboundary settings, or political boundaries that intersect with resource boundaries, can produce barriers to knowledge production and use, and therefor create knowledge gaps and fragmentation. One state employee mentioned that in a boundary setting such as the McDermitt Caldera, there are "cracks" and with state borders there can be "…borders between agencies". Compounding knowledge gaps and uncertainties in these settings can lead to ineffectiveness of environmental regulators, with implications of wide-spanning social and ecological outcomes (Armitage et al., 2015; Lappe-Osthege, 2023; Miller et al., 2022).

To sum, interviewees communicated frustration concerning inter-agency knowledge fragmentation, lack of environmental baseline data, and lack of local groundwater knowledge that together render the McDermitt Caldera vulnerable to mining interests. While this echoes the results from other political ecology literature on knowledge politics and environmental change, it is worth pointing to the complexity of this particular situation. There are multiple knowledge gaps stemming from lack of knowledge around groundwater; the fact that the McDermitt Caldera crosses political boundaries; and its location in a remote area—to name a few. Knowledge gaps cannot, in this case, be pinpointed to a single factor. This points to the importance of considering multiple overlapping sources of knowledge gaps simultaneously.

9.3 Mining Operations and Wildlife Habitat

Throughout my interviews with actors involved with the McDermitt Caldera, several participants emphasized the Caldera's ecological importance. Many described it as a critical refuge for sensitive species within the state of Oregon, and emphasized that intact, expansive, and continuous landscapes such as the McDermitt Caldera's were becoming increasingly rare. These accounts influenced my spatial analysis, which aimed to triangulate these impressions by analyzing the distribution of habitats of state-recognized sensitive species, asking how many of these sensitive species' habitats intersected with mining operations, and what percentage of their habitat could be affected by the mining project's footprint.

Sensitive species were identified through the Oregon Conservation Strategy, run by ODFW. The Conservation strategy identifies sensitive species as "Species of Greatest Conservation Need" and thus classifies them as Strategy Species (Oregon Conservation Strategy, 2016). Of the 33 Strategy Species whose habitats were analyzed to investigate spatial overlap with mining operations, 25 habitats overlapped, accounting for 75% of the total. The percentage of total habitat that overlapped with mining operations was variable for species, with 31 out of 33 species having >1.0% overlap. It is important to note that calculating the percentage of habitat that could be affected by mining operations on the Oregon side of the McDermitt Caldera did not take a cumulative approach, in that it did not consider other factors outside of the area of interest that could cause habitat degradation and fragmentation (for example, other land use changes across habitat ranges). Additionally, the 2-mile buffer that was applied does not account for the full extent of potential operations, as these can have impacts to waterbodies and ecosystems beyond the distance that was used in this study.

A considerable body of wildlife research supports the claim that a cumulative approach is essential for understanding contemporary wildlife range and habitats, as individual changes in land use may not appear to have a large impact initially, however, their accumulation over space and time may constitute significant impact (Coffin, 2007; Davies et al., 2021; Krausman et al., 2011; Shifley et al., 2008; Theobald et al., 2017). This is important given the many mining claims across Nevada and Oregon. For this reason, there cannot be conclusive evidence regarding total species habitat disruption from this study, however, the large percentage of sensitive species within the Northern Basin and Range ecoregion whose habitat intersect with mining operations does shed light on potential institutional conflicts between ODFW, DOGAMI, and the BLM, each with their own set of priorities and directives. ODFW's Conservation Strategy was designed to conserve fish and wildlife, while DOGAMI's Mineral Land Regulation and Reclamation program prioritizes the management of natural resources with the stated goal of prosperity for the state of Oregon (Oregon Department of Geology and Mineral Industries, 2021). Furthermore, mining is an important land use under the BLM's multiple-use mandate (Bureau of Land Management, n.d.), and in the context of domestic critical minerals, mining is an even higher priority (Ladislaw et al., 2019). The multiple environmental managers overseeing this region and this operation is what Benson (2012) describes as not singular, but instead "…a mosaic of overlapping and often contradictory authorities" (p. 1445). This complexity is evident in the differing priorities of agencies like ODFW's Conservation Strategy, which prioritizes species and habitat conservation versus organizations like DOGAMI and BLM, which have resource-driven goals.

A particular point of concern among interviewees was how mining operations would affect the local Greater Sage-grouse population, a species who is tied so a specific ecosystem that has faced tremendous habitat loss due to various land use changes, notably from livestock grazing, mining, and energy development, a majority of which is on public land managed by the BLM or U.S. Forest Service (Braun, 1988; Davies et al., 2011; Lucas & Stellberg, 2021; Walker et al., 2008). The overlay analysis revealed that 0.70% of the Greater Sage-grouse's habitat could be disrupted from the mining operations on the Oregon side of the McDermitt Caldera. While this number seems quite low, when framed in a different manner, nearly 100% of potential mining operations in the Caldera occupy Sage-grouse habitat (and most species analyzed in this study). The calculations in this study do not factor in other disruptions to the species' range but does shed light on one type of land disturbance in one area.

The uniqueness of the Caldera was a recurring topic in interviews, in the context of Greater Sage-grouse, it was the Caldera's intact habitat, healthy ecosystems, and expansive continuity that were essential for local Sage-grouse populations. Given the dire circumstances for the species, certain participants felt that the Caldera was essential for their continued survival. As highlighted earlier, the priorities if environmental managers operating in the McDermitt Caldera could prove to be out of alignment, especially in the context of Sage-grouse protections, as some believe that the future of their existence rests solely on how public lands and their extracted resources are managed (Lucas & Stellberg, 2021).

Scholars have identified major knowledge gaps surrounding biodiversity conservation and renewable energy projects (Gasparatos et al., 2017; Katzner et al., 2013; Serrano et al., 2020), arguing that while a transition to more sustainable energy systems is vital, the implications for ecosystems, habitats, and non-human life that rely upon these areas need to be considered in the energy transition. In interviews for this research, there was a shared feeling among many that places like the Caldera were disappearing, and the consequences of these transformations escalated habitat disturbance, degradation, fragmentation, and permanent loss, all of which are drivers for biodiversity loss (Fahrig, 2003; Groom et al., 2006; Hanski, 2011). Triangulating the qualitative interviews with a spatial analysis helps to understand whether this feeling is grounded in data. The spatial analysis conducted for this study shows that concerns that open-pit lithium mining could negatively impact local biodiversity are, indeed, substantiated.

10. Conclusion

When I asked interview participants about their perspective on renewable energy technologies writ large, there was a shared consensus that climate change was an existential threat that required intervention, yet the proposed methods and deployment of renewable energy technologies was met with skepticism and uncertainty. Moreover, there was an agreeance on the misrepresentative language that these technologies are fully "clean," "green," and environmentally friendly. A considerable amount of literature has been published on the contradictions embedded within the branding of environmental technologies, underscoring the cultural, social, and environmental toll that renewable energy technologies have via the intense use of resources and large project footprints (Canelas & Carvalho, 2023; Gibson et al., 2017; Knuth et al., 2022; Levenda et al., 2021; Mulvaney, 2013; Sovacool, 2021). When the subject of EV technology and lithium extraction was incorporated into our interviews, there were varying levels of acceptance and divergent perspectives regarding solutions to decarbonizing. Participants who were less opposed to, or in favor of mining operations in the Caldera argued that lithium is the current solution that is available, and because of the urgency of climate change, this was a necessary trade-off that should be capitalized upon. One interviewee contended that lithium "got there first", implying that the path forward was set. Those who were against mining expressed that the environmental costs were too high, citing the landscape transformation requirements needed for mining, the resources that were required (including fossil fuels for the process of constructing/operating the mine), the possibility of pollution, and the effects this would have on species within the area. Additionally, many participants felt the Caldera was understudied, misunderstood, and therefore was in danger of being mismanaged.

The place-based, case-study approach employed in this study revealed the nuanced trade-offs and competing perceptions embedded within renewable energy projects and the logistics of their creation. While some participants view mining as a necessary means to achieve sustainable development and combat climate change, others see it as an unacceptable environmental cost, sacrificing irreplaceable ecosystems and species for perceived progress. This divergence underscores the complex, often contradictory narratives surrounding renewable energy technologies. Such technologies, while branded as 'green,' require significant resources that can undermine their sustainability claims. As this study indicates, even as renewable energy technologies play a critical role in addressing the existential threat of climate change, their deployment raises substantial questions about the balance between local-scale ecological preservation and global sustainability goals.

Addressing the research questions that guided this study, I found that actors involved in Oregon's section of the McDermitt Caldera perceive lithium extraction in diverging and often competing ways. First, there was a shared consensus that decarbonizing to mitigate the effects of climate change was mandatory, yet many were ambivalent to current proposed solutions and skeptical that lithium was the answer. I conclude that either biocentric or anthropocentric values shaped understandings of open-pit lithium mining in the Caldera. Those that perceived open-pit mining as a threat to the Caldera and believed that the area should be preserved represent the biocentric perspective, that the landscape should function as a natural refuge for systems outside of human life. Others saw the landscape as a utility for human gain, representing anthropocentric values. It was within these values that narratives of support or opposition were formed, which answered my second research question. Support for mining operations highlighted economic benefits and technological advancements for the state of Oregon. Oppositional narratives largely focused on the intact habitat within the Caldera, with beliefs that sacrificing the Caldera was an unacceptable trade-off for a domestically supported "green" future. Additionally, many felt there is a lack of understanding from environmental managers of the area and were critical of the landscape transformations that could happen under this lack of knowledge. Finally, I found that 75% of habitats of selected Strategy Species within the Northern Basin and Range ecoregion had overlapped with, or "interacted" with mining operations. While the findings in the overlay analysis cannot definitively calculate overall habitat disruption for each species, it does highlight common critiques of renewable energy projects and their potential for fragmentation, degradation, or destruction of ecosystems, and the lasting effects that these changes can have on the biodiversity of a region. Additionally, it revealed institutional contradictions and potential conflicts of interest between state agencies involved in the permitting process should mining operations advance.

Using a political ecology framework, I examined the nuanced perspectives that are attached to resource-driven landscape changes, and how these perspectives symbolize deeper meanings and values. My research connects to a larger body of scholarly work surrounding lithium extraction and renewable energy technologies, demonstrating the importance in place-based research. The findings highlight that the push for lithium, driven by global demand for renewable energy under the threat of climate change, is not just a technological shift but a transformation full of power struggles and ecological trade-offs. This aligns with political ecology's emphasis on understanding the socio-political ramifications of environmental change, where environmental policies are often intertwined with issues of control, resistance, and justice. By using a mixed-method approach within this study, I was able to connect perspectives surrounding the McDermitt Caldera’s ecologic importance with sensitive species within the state, identifying potential future conflicts should mining operations move forward. Additionally, I was able to identify the local knowledge gaps by environmental managers within the area, particularly relating to groundwater availability.

This study is a call for more attention to places of extraction and sites of renewable energy projects. While the urgency of climate change encourages immediate action, there should be thoughtful examination of the proposed solutions and the wider reach of their implementation. Particularly in the McDermitt Caldera, future research should examine groundwater availability and surface water connectivity. From an environmental management perspective, there should be more existing baseline data created before mining companies are given permits to use high amounts of water. Due to the decline of expansive sagebrush habitats, further research regarding the cumulative effects of a lithium mining operation would be beneficial for guiding future management decisions. Additionally, further research on the species that occupy these threatened habitats should be undertaken, in relation to lithium mining and the cumulative effects of land use changes.

Renewable energy technologies are a critical component of mitigating the effects of climate change. As society works to decarbonize and transition to more sustainable energy systems, it is vital to understand the permanence of these decisions, and the human and non-human factors that are directly affected by them. As Ketan Joshi (2023) notes:

> It is because climate action is so urgent that we should be careful with how we roll out clean energy. If you are worried about climate impacts, you should worry about how to ensure [...] it doesn’t happen in a self-sabotaging and destructive way.

It is through this careful consideration of local landscapes and the communities with whom they hold meaning and importance that a just energy transition can be achieved.

10.1 Limitations

As with any research, the study had several limitations, primarily due to time constraints, that point to areas for future research.

- It is important to note that there are many actors involved in the McDermitt Caldera that I did not interview, and my findings do not represent all perspectives on this matter. There are many Indigenous groups who are organizing around this project; due to timing constraints and scheduling, there were no Indigenous voices within my interviews. Indigenous perspectives are not a monolith, and recognizing their diversity, in addition to the ramifications of projects like this one, is crucial. Currently, other researchers are including these voices within their own research on the Caldera, which will ensure a more comprehensive understanding of community impacts and cultural significance associated with mining activities in the region.

- As reflected in my interview data, the transboundary setting of the McDermitt Caldera brought many challenges. This was especially true for GIS data. When I began this research I wanted to perform a spatial analysis of the entire Caldera. This was not done due to inconsistent data availability between the two states. Additionally, my original plans involved mapping groundwater depths within the Caldera, however there was very limited well data within the state of Oregon. Transboundary spatial analysis is a difficult, yet important, task for future researchers and decision makers.

- Due to the geographic distance between myself and the Caldera, I only visited the site two times during my research. Given the importance of this location to many people that I interviewed, I believe more time in the Caldera would have influenced my own work even further.

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Appendix: Interview Questionnaire

1. What is your involvement or interest in the potential extraction of lithium in Malheur County?
    a. What do you think about the idea of lithium mining in this area?

2. How would a lithium mine change this area?
    a. What are the impacts on land, water, and wildlife? b. What are the impacts on people locally?

3. What do you see as the positive aspects & benefits for this operation?
    a. Who benefits the most?
    b. Who should benefit?

4. What do you see as potential challenges or downsides for this operation?
    a. Who or what benefits the least? Who/what might be harmed?

5. Can you tell me about any potential conflicts you see arising from the proposed mining operations?
    a. What are some of the underlying reasons for conflict?
    b. Who do you think would be involved and why?

6.What are some of the different ideas that exist around lithium extraction in Malheur County? What are potential futures, what stories are being told from different perspectives?
    a. How do these ideas influence public perception?

7. From your perspective, how do you see the role of government and regulatory bodies factoring into this operation?
    a. Where are they effective?
    b. Where do they do fall short?
    c. [If relevant and in line with conversation] – are there specific laws or policies you see as particularly important or influential? What, how so?

8. What is your perspective on the role of domestic lithium extraction in the larger context of energy transitions to combat climate change?
    a. Are there alternatives that you think are better, or worse?

9. How do you see this project connecting to other places?
    a. How does it connect to similar projects in other places?
    b. How is it different?

10. What is your vision for the future of Malheur County and how does lithium extraction fit into this vision?
    a. What does this landscape mean to you?

11. What else should I be asking that I didn't ask? What else should I know? Who else should we be talking to?