Chuckwalla National Monument Climatological Values Survey

The role of natural and working lands in mitigating atmospheric CO_2 has gained traction within the scientific and policy maker communities, specifically state and federal 30x30 Executive Orders (Exec. Order No. N-82-20, 2020 and No. 14008, 2021 respectively). The proposed national monument in eastern Riverside and Imperial Counties offers notable opportunities for a solutions-based approach to the suite of threats stemming from increased temperatures and precipitation variability projections for this region. Specifically, the proposal's approximately 680,000-acre expanse includes desert flora and soils that actively sequester carbon (Luo et al., 2007); it also helps broaden wildlife corridors that are essential for the migration of desert fauna in response to climate change (Game et al., 2011) which will help preserve biodiversity in the lower desert of California.

On January 27, 2021, the Biden Administration issued EO 14008, Tackling the Climate Crisis at Home and Abroad. The President's directive articulated a focused path forward for the role of our nation's lands and waters in addressing the climate crisis. The challenge to conserve 30% of our nation's lands and waters by 2030 was drafted as a response to our global climate crisis. In Conserving and Restoring America the Beautiful, Principle 7 states:

> Studies of the carbon sequestration potential of lands and the ocean; of biodiversity loss, ecosystem services, and the movement and migration of wildlife; and of air and water pollution are part of a large and growing body of scientific information that can help guide decisions about how the nation should manage, connect, and conserve its lands and waters (U.S. Department of the Interior et al., 2021).

Modeled Projections for Temperature and Precipitation in Riverside County

Climate scientists have modeled regional projections for Riverside County, though these projections should be understood to be derived across the entirety of the county, which includes both densely populated areas with high levels of development and infrastructure, as well as the locale for the proposal, situated in low population density and minimal development.

The High Emissions scenario [RCP 8.5] was developed as a "very high baseline emission scenario" of no-policy baseline scenarios (Harrisson, 2021). With state and federal policies, including implementation of natural and working lands strategies, actively being employed, the

relevance of a High Emissions [RCP 8.5] scenario diminishes. High Emissions scenarios serve as a cautionary example of where we are heading without policy intervention and strategic actions, including carbon sequestration with natural and working lands.

Temperature

By End-Century, the 30-year average temperature change for Riverside County from baseline is projected to increase by +5.3°F under Medium Emissions [RCP 4.5], and by +8.7°F under High Emissions [RCP 8.5] (Cal-adapt, n.d.).

Precipitation

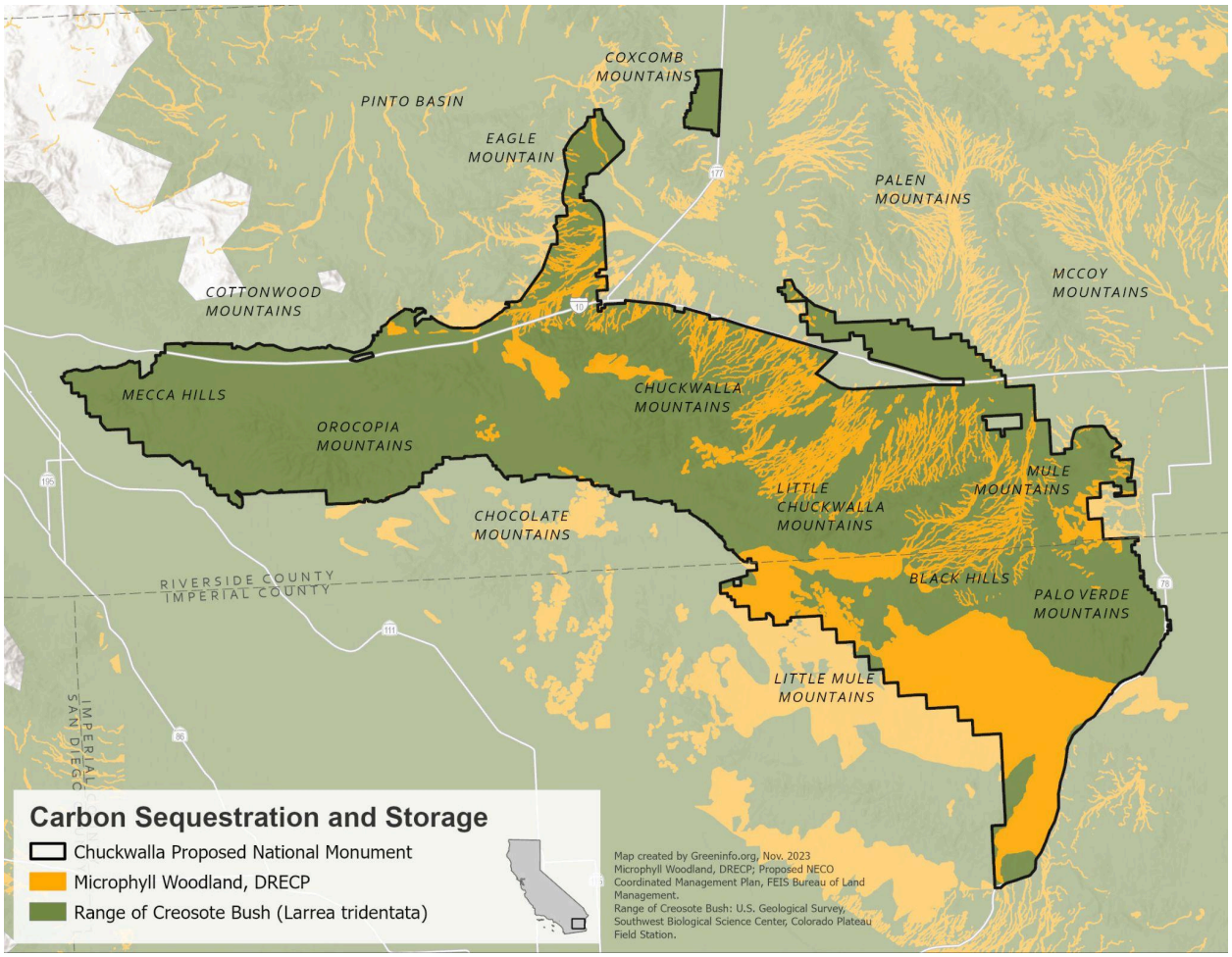
By End-Century, the 30-year average for precipitation is projected to increase by +.2" from baseline under Medium Emissions, and by +1.2" under High Emissions (Cal-adapt, n.d.).

Conserved Deserts Lands as Vast Carbon Sinks and Connectivity Corridors in the Face of Climate Change Threats

Natural lands are a centerpiece of 30x30 goals targeting climate change (Smith and Young, 2022). The proposed Chuckwalla National Monument presents an opportunity to simultaneously sequester carbon emissions above- and below-ground in a stable, durable storage environment, and to facilitate the movement of desert animals to suitable climate envelopes, protecting the desert region's remarkable biodiversity.

Desert Carbon Sequestration

Carbon sequestration in the California desert region is much more significant than has been widely recognized. The desert landscape in this state is a considerable carbon sink. Dr. Lindsay Rosa's analysis indicates that up to 10% of California's carbon emissions are stored within our state's desert ecosystem. (Rosa, 2022). With the proposed acreage for the Chuckwalla National Monument standing at approximately 670,000 acres, this represents almost 5% of Bureau of Land Management (BLM) managed public lands in California (BLM n.d.).



Map illustrates extensive **microphyll woodland and creosote bush range** found within Chuckwalla National Monument proposal boundaries. These vegetation types are significant contributors to carbon sequestration in the desert.

Within the proposal site's boundaries are two notable habitat communities for high levels of carbon sequestration: microphyll woodlands and creosote bajadas (BLM CDD and CDFG, 2014; Cole, 2011). Both of these communities have high net ecosystem exchange (NEE) values. This means that the balance between carbon absorbed during photosynthesis and carbon released during respiration is positive, resulting in a net loss in atmospheric carbon concentration. With high annual variability, NEE in microphyll woodlands can exceed 200 kilograms of carbon per hectare per year (kgC/ha/y) and NEE of creosote bajada scrub over 1000 kgC/ha/y. By comparison, 100-year old chaparral during a drought year has an NEE value of 180 kgC/ha/y, and a LaSelva tropical rainforest during a dry year has an NEE value of 1000 kgC/ha/y (Allen, 2023).

Based on California's 4th Climate Change Assessment's acreage assessment of microphyll woodlands and creosote habitat for the Inland Desert Area, it can be estimated that an average of

1.5 million tons of carbon may be accumulated by these two vegetation types annually, comparable to the range for coniferous forests or oak woodlands in southern California (Allen, 2023).

Permanent protection for such a large-scale national monument proposal as presented here not only conserves and protects our natural resources, but also invests in a national urgency: a durable, functional large-scale carbon sink (White House, 2022).

The process for carbon sequestration in desert regions such as the proposed Chuckwalla National Monument differs from those more readily understood in forested ecosystems. While carbon sequestration does occur in desert biomass aboveground, much of the carbon in this ecosystem is stored belowground, in calcium carbonate soil layers termed caliche (Marion et al., 1985).

Caliche layer within Chuckwalla boundary proposal. Photo by Colin Barrows @CactusToCloud.

As botanist Robin Kobaly (2019) outlines, a complex relationship exists between plant roots and fungi that results in long-term, underground carbon storage:

> Both the root and the fungus are breathing out carbon dioxide in the dark (plants breathe in carbon in the light and breathe out carbon in the dark). Right at the point where a tiny fungal thread connects to the plant root, some of the carbon dioxide exhaled by roots and

fungi reacts with calcium in the soil to form crystals of calcium carbonate, or what is called caliche. Carbon in these crystals becomes locked into the soil.

The key benefit of desert carbon sinks is that they provide a cost-effective strategy for climate change mitigation: leaving the land undisturbed. Only when desert soils are subject to (usually) human initiated disturbance is carbon released back into the atmosphere (Allen et al., 2014).

Habitat Connectivity and Climate Resilience

In addition to contributing durable carbon sequestration, one of the key objectives of a new Chuckwalla National Monument is to provide expansive wildlife connectivity.

Appendix P of the DRECP BLM LUPA (BLM, 2015) notes, "Conservation areas that are *large and connected* with minimum edges and that capture environmental gradients are more likely to allow species and vegetation to adapt to changing conditions [italics added,]" The Appendix further emphasizes that "... currently suitable habitat may no longer be in the future, resulting in modified species distributions, species abundance, and inter-specific interactions across the landscape.... The ability of species to respond and/or adapt to changing environmental conditions will determine future species distributions and community compositions" [p.3].

Parmesan et al. (2014) note emerging documentation that ecosystems less degraded initially by human activities are both more resistant and more resilient to alterations under extreme climate events. While actual reduction of carbon emissions is an ongoing state, national, and global process, ecosystem resistance and resilience can be fostered by traditional conservation strategies, namely increasing habitat connectivity.

As noted at the start of this section, Riverside County is projected to experience temperature increases by 5.3 °F under the Medium Emissions scenario discussed above by End-Century, with variability in precipitation (Cal-adapt, n.d.). Research based on niche modeling has indicated that with moderate predictions of climate change in both temperature and precipitation, suitable habitat for desert tortoises was reduced by nearly 88% in the Sonoran Desert; for chuckwallas, suitable habitat was reduced by nearly 92% in the same locale. (Barrows, 2011). These projections represent drastic reductions in iconic desert species populations, including threatened species. Capacity to adapt to these drastic changes is promoted by large, contiguous landscapes such as the Chuckwalla National Monument proposed boundary.

The implications of climate change threats for desert species populations can be mitigated by advancing wildlife connectivity (BLM, 2015), one of the critical endeavors for the Chuckwalla National Monument proposal. Connectivity supports wildlife movement and promotes adaptation to suitable climate envelopes for special status species, while promoting resilience for species not yet identified as special status.

Conclusion

As climate change progresses, California's desert regions are projected to experience increased average annual temperatures and variability in precipitation (BLM, 2015). These two abiotic climatic driving forces – warming temperatures and decreasing/inconsistent water availability – are primary determinants of species' range (BLM, 2015). Conservation of large expanses of desert lands as proposed here in the Chuckwalla region addresses two urgent climate concerns.

By sequestering significant quantities of atmospheric carbon underground, the desert serves as a vast carbon sink, capturing carbon and mitigating carbon emissions for the long term if left undisturbed. At the same time, establishing the national monument provides adaptive relief from current conditions by creating the corridors necessary for species movement to more suitable temperature and precipitation ranges, and access to food sources in response to vegetation shifts in the region.

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